GSI GRAIN CONDITIONING SYSTEMS

2009 TOWER DRYER

OPERATION AND SERVICE MANUAL

PNEG-526
12', 16', 24', & 30'
Diameter Dryer Models

GSI GROUP

PNEG-526

THIS PRODUCT IS PROTECTED UNDER ONE OR MORE OF
THE FOLLOWING U.S. PATENTS:

6233843, 6189235, 6141886, 6101742, 6098305, 6088929, 6076276, 6073367, 6073364, 5570521, 6457256, 6035544, 5860221, 5653043, 5651193, 5604996,5566470, 5400525

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Allen-Bradley Variable Frequency Drive
Maxon "NP-LE" Burner
Maxon "CV" Gas Control Valve
Maxon "808" Gas Shut-Off Valve
Nord Gear Reduction Gear Unit
Sumitomo Cyclo-Drive Gear Unit
Honeywell Modutrol IV Motor Actuator
Invensys 121 Gas Regulator
ASCO Solenoid Valves
Protection Controls Protectofier Service Manual

DRYER OPERATIONS

SAFETY GUIDELINES

This manual contains information that is important for you, the owner/operator, to know and understand. This information relates to protecting ***personal safety*** and ***preventing equipment problems***. It is the responsibility of the owner/operator to inform anyone operating or working in the area of this equipment of these safety guidlines.To help you recognize this information, we use the symbols that are defined below.
Please read the manual and pay attention to these sections. Failure to read this manual and it's safety instructions is a misuse of the equipment and may lead to serious injury or death.

This is the safety alert symbol. It is used to alert you to potential personal injury hazards. Obey all safety messages that follow this symbol to avoid possible injury or death.

⚠ DANGER **DANGER** indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.

⚠ WARNING **WARNING** indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.

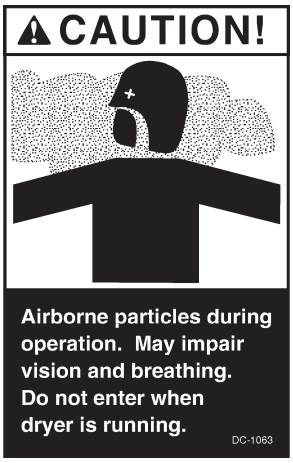
⚠ CAUTION **CAUTION** indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury.

CAUTION **CAUTION** used without the safety alert symbol indicates a potentially hazardous situation which, if not avoided, may result in property damage.

NOTE **NOTE** indicates information about the equipment that you should pay special attention to.

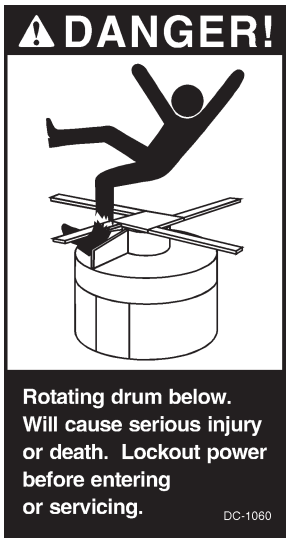
The GSI Group Inc.'s principle concern is your safety and the safety of others associated with grain handling equipment. This manual was written with that thought in mind. We want to keep you as a customer by helping you understand safe operating procedures, and some of the problems that may be encountered by the dryer operator or other personnel.

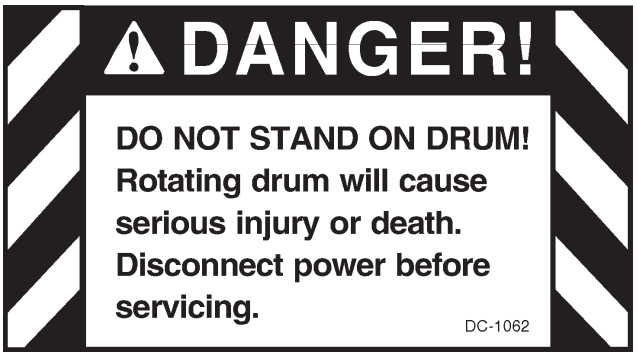
As owner and/or operator, it is your responsibility to know what requirements, hazards and precautions exist, and to inform all personnel associated with the equipment or who are in the dryer area. Avoid any alterations to the equipment. Such alterations may produce a very dangerous situation, where serious injury or death may occur.


⚠ CAUTION!
Airborne particles during operation. May impair vision and breathing. Do not enter when dryer is running.
DC-1063

⚠ WARNING!
High speed belt drive operating overhead. Can cause serious injury. Keep head and hands clear. Do not enter when dryer is running.
DC-1064

⚠ DANGER
Disconnect electricity before inspecting or servicing.
Keep guards and screens on exposed areas.
MAY CAUSE SERIOUS INJURY OR DEATH
DC-466
1992 GRAIN SYSTEMS INC.





The GSI Group, Inc. recommends you contact your local power company and have a representative survey your dryer installation, so your wiring will be compatible with their system and you will have adequate power supplied to your unit.

Safety decals should be read and understood by all people in and around the dryer area. If the following safety decals are not displayed on your dryer, or if they are damaged, contact The GSI Group, Inc. for replacement:

The GSI Group, Inc.
1004 E. Illinois St.
Assumption, Illinois 62510
phone: 217-226-4421 • fax: 800-800-5329

READ THESE INSTRUCTIONS BEFORE OPERATION AND SERVICE

SAVE FOR FUTURE REFERENCE

1. Read and understand the operating manual before trying to operate the dryer.

2. Never operate the dryer while any guards are removed.

3. Power supply should be **OFF** for service of electrical components. Use CAUTION in checking voltage or other procedures requiring power to be **ON**.

4. Check for gas leaks at all gas pipe connections. If any leaks are detected, do not operate dryer. Shut down and repair before further operation.

5. Never attempt to operate the dryer by jumping or otherwise bypassing any safety devices on the unit.

6. Do not exceed maximum recommended drying temperatures.

7. Keep the dryer clean. Do not allow fine material to accumulate in the plenum chamber.

8. Keep blower drive belts tight enough to prevent slippage.

9. Use CAUTION in working around high speed fans, gas burners, augers and auxiliary conveyors which START AUTOMATICALLY.

10. Do not operate in any area where combustible material will be drawn into the fan.

11. Be certain that capacities of auxiliary conveyors are matched to dryer metering capacities.

12. Clean grain is easier to dry. Fine material increases resistance to airflow and requires removal of extra moisture.

13. Do not adjust any moving part on the dryer while it is running.

Use Caution In The Operation Of This Equipment

The design and manufacture of this dryer is directed toward operator safety. However, the very nature of a grain dryer having a gas burner, high voltage electrical equipment and high speed rotating parts, does present a hazard to personnel, which can not be completely safeguarded against, without interfering with efficient operation and reasonable access to components.

Use extreme caution in working around high speed fans, gas-fired heaters, augers and auxiliary conveyors.

KEEP THE DRYER CLEAN

DO NOT ALLOW FINE

MATERIAL TO

ACCUMULATE IN THE

PLENUM CHAMBER

OR SURROUNDING THE

OUTSIDE OF THE DRYER

Continued safe, dependable operation of automatic equipment depends, to a great degree, upon the owner. For a safe and dependable drying system, follow the recommendations within this manual, and make it a practice to regularly inspect the operation of the unit for any developing problems or unsafe conditions.

Take special note of the safety precautions listed above before attempting to operate the dryer.

Electrical

The dryer can be furnished to operate off of 240, 480, or 575 volt, 60 Hz power or 380 volt, 50 cycle power. The dryer is furnished with a power panel equipped with a main circuit breaker disconnect and motor starters and branch breakers for the individual blower motors. Standard blower motor starting is across-the-line starting. When necessary, the dryer can be equipped with optional soft-start motor starting equipment.

No dry grain conveyor is furnished with the dryer, however, a 10 hp motor starter for a dry grain conveyor is furnished in the control panel. If the dryer is ordered with a demand fill, a 10 hp motor starter is also provided in the control panel to operate a wet conveyor.

GSI personnel will perform all necessary dryer wiring from the power panel to the dryer. The customer is responsible for bringing electrical power into the main circuit breaker and also for wiring the unload (and load) conveyor.

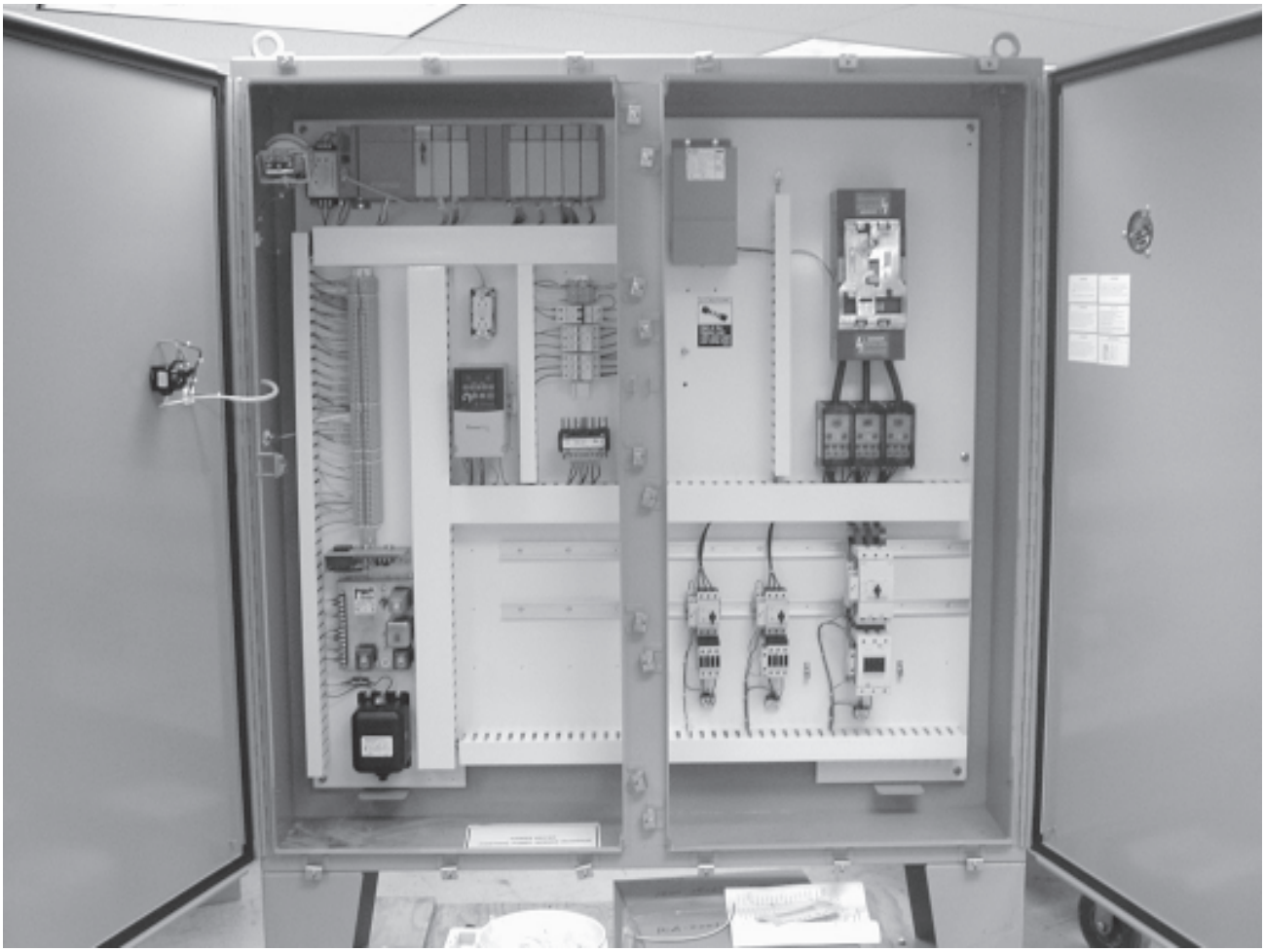
A wiring diagram is furnished with each dryer. Extensive safety controls are used on the dryer for equipment and personnel protection and should not be bypassed.

Fuel

The burner is designed to burn either natural gas or propane vapor fuel. The volume of fuel supplied must be sufficient to maintain a minimum of 7 to 10 psi pressure when the burner is operating at rated capacity.

When propane is used as the fuel source, external propane vaporizers must be used in order to supply vapor gas to the dryer. Vaporizers must be sized to the burner capacity of the dryer. Fuel pressure to the dryer must be regulated to approximately 10 psi.

GSI personnel will plumb all necessary gas piping from the dryer's gas shutoff valve to the burner. The customer must provide fuel to the gas shutoff valve.



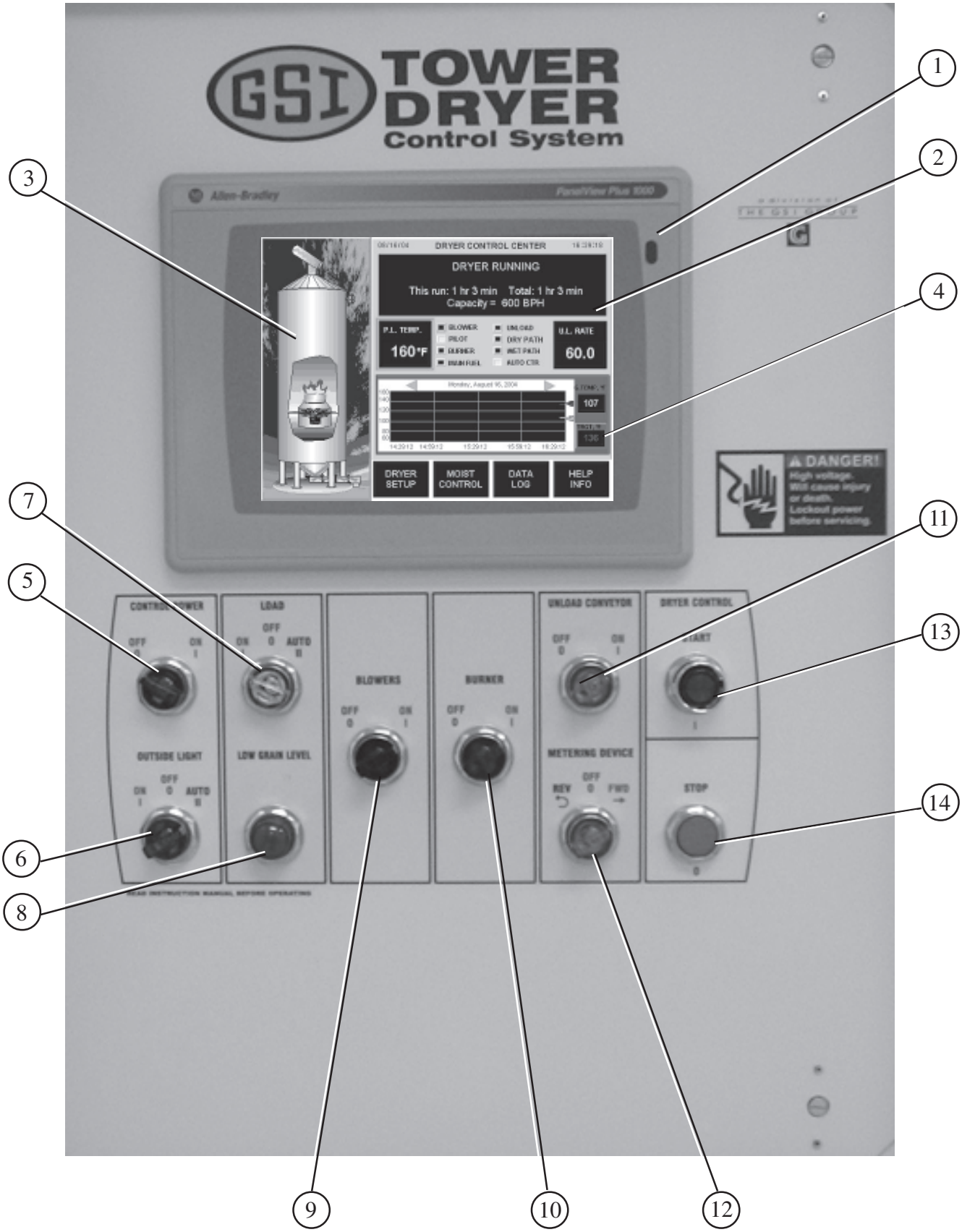


Figure 1: The grain dryer control panel with full color touch screen control.

Dryer Control Panel Featuring The Allen-Bradley PLC Control System

1. Full Color Graphical Display provides continuous visual feedback on the current dryer status as well as a convenient means of setting operating parameters and options. Most set points and status screens are accessed by simply touching an on-screen object.

2. Message Center displays current dryer conditions and alarm messages with toubleshooting tips in easy to read language.

3. Dryer View provides a quick visual indication of primary dryer functions as well as easy access to current burner and grain flow status screens.

4. Temperature/Moisture History Chart records up to 32 hours of dryer temperature and/or moisture data (with optional moisture control). The chart can be easily "rewound" to view earlier drying conditions.

5. Control Power Switch energizes the control panel and the PLC Control System. (NOTE: It takes approximately 60 seconds to power up the **Full Color Graphical Display** once the **Control Power Switch** is turned on).

6. Outside Light Switch turns the dryer service light on or off. On "AUTO", the light turns on when the dryer is running and off when a shutdown occurs.

7. Load Switch controls the filling of the dryer. The "ON" position initially fills the dryer. The "OFF" position turns the conveyor off/shuts the slide gate. The "AUTO" position enables automatic fill control and the OUT OF GRAIN TIMER.

On dryers filled on demand with a conveyor or slide gate:
In the "ON" or "AUTO" position the fill conveyor turns on / slide gate opens when the dryer is low on grain and off / closes when the dryer is full. In the "AUTO" position only, the dryer will automatically shut down when the dryer is low on grain and the OUT OF GRAIN TIMER expires.

On choke filled dryers:
In the "AUTO" position only, the dryer will automatically shut down when the dryer is low on grain and the OUT OF GRAIN TIMER expires.

In the "ON" or "OFF" position the OUT OF GRAIN TIMER IS DISABLED.
The LOAD switch is illuminated whenever the load conveyor is running.

8. Low Grain Light flashes when the grain level is low and the OUT OF GRAIN TIMER is running. The LOW GRAIN light is on steady when the timer expires.

9. Blowers Switch turns the blower(s) on or off. On multifan dryers, the blowers start sequentially. The lighted switch flashes during blower start-up. The switch is illuminated when all of the blower airflow switches close indicating that the blowers are operating correctly. After the closure of all of the airflow, the dryer automatically goes through a 30 second purge cycle.

10. Burner Switch turns the burner on or off. When the switch is turned on, the burner pilot will automatically light, after the purging cycle is completed. The lighted burner switch will flash during the 15 second pilot ignition time. The switch illuminates when the pilot flame is sensed at the pilot. After the pilot flame is established the Maxon shut-off valves in the fuel train are energized. Motorized valves will automatically open to provide gas to the main burner. Manual valves must be opened manually to supply gas to the main burner.

11. Unload Conveyor Switch turns the dry grain unload conveyor on or off. The switch illuminates when the conveyor is operating.

12. Metering Device Switch turns the metering device on or off in forward or reverse. The device will not run unless the unload conveyor is on. The switch illuminates when the metering device is discharging grain.

13. Dryer Power Start Button initiates automatic operation of the dryer. When depressed, the dryer begins the startup cycle and operates based on the positions of the selector switches on the control panel. To control the operation of individual components, first depress the DRYER POWER START button, then turn on the individual dryer components as desired.

14. Dryer Power Stop Button manually stops all dryer functions and automatic equipment in a controlled shutdown sequence.
Important: *In case of an automatic dryer shutdown, the DRYER POWER STOP button must be depressed before the dryer can be restarted.*

1. **Prepare dryer for start up**
   Perform preseason inspection and service as outlined in the Maintenance Section before attempting to operate the dryer.

⚠ The dryer must have all Pre-Season and Post-Season maintenance to ensure reliable operation

   Make sure all discharge doors, grain exchanger cleanout doors, heat section door, louvered cooling section doors, etc. are closed. Make sure that all personnel are clear of the dryer and any grain handling machinery.

2. **Open main gas valve** to dryer.

3. **Switch on main breaker** to provide electrical power to the dryer by placing the main circuit breaker handle located on the dryer power panel to the "ON" position.

4. **Pull out both Emergency Stop Buttons** located on the side of the control and power box to enable the main PLC circuit.

5.1 **Switch on the control panel** by turning the CONTROL POWER selector switch to the "ON" position. The switch will illuminate indicating that the control panel has power and is operating correctly. After a short series of self-diagnostic tests, the LCD display screen will display a copyright message and a start button.

5.2 **Press the on-screen Start button to enter the dryer status screen.**

6. **Press the DRYER POWER "START" button** to activate the LOAD, BLOWERS, BURNER, UNLOAD and METERING DEVICE selector switches on the control panel.

7. **Start auxiliary equipment** needed for filling dryer. (ie. wet legs, conveyors, etc.)

8. **Fill the dryer** by turning the LOAD selector switch to the "ON" position. On a demand fill dryer, the wet conveyor will turn on / slide gate will open and the dryer will start filling with grain. Once the dryer is full, a horn will sound and the wet conveyor will stop / slide gate will shut. Turn the LOAD selector switch to the "AUTO" position to silence the alarm and begin normal dryer operation. In the "AUTO" position, the dryer automatically controls the conveyor / slide gate and the OUT OF GRAIN TIMER is enabled, allowing automatic shutdown if the dryer remains low on grain after a preset period of time.

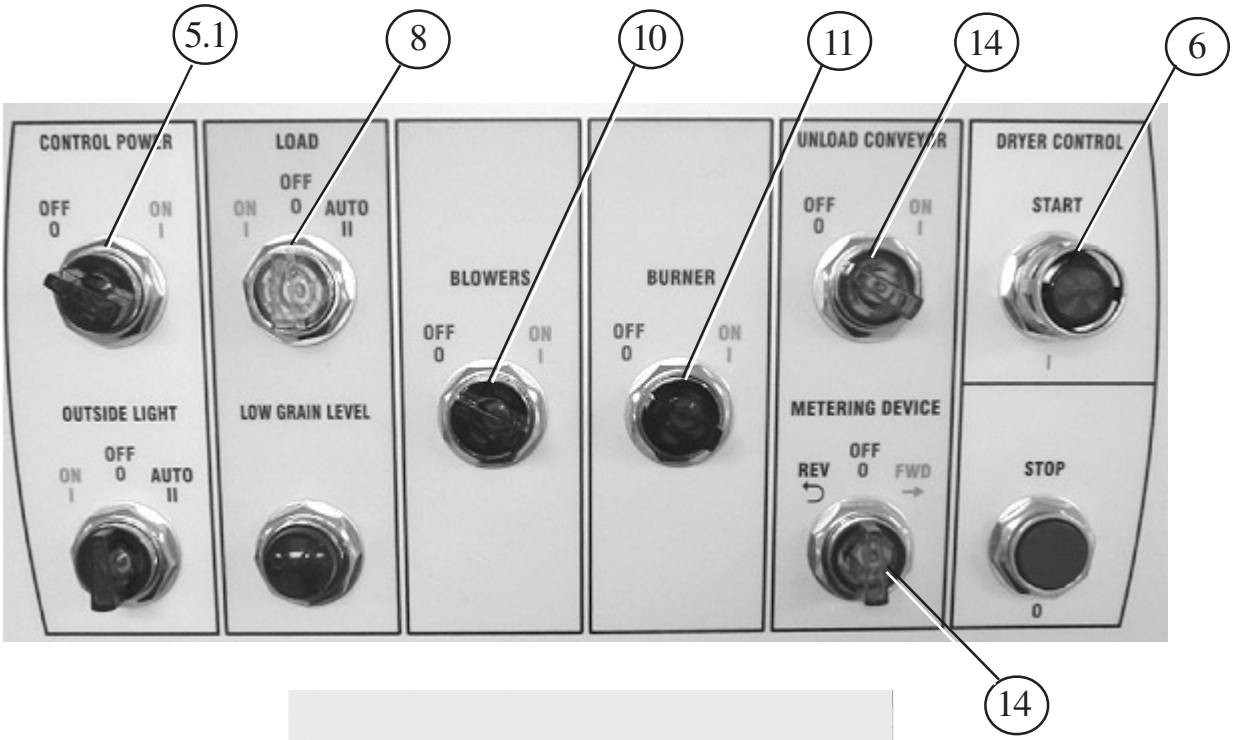
⚠ The burner should be covered before filling the dryer to prevent accumulation of foreign material on the Ignitor, Flame Sensor, and Burner Ports. Foreign material may interfere with burner operation.

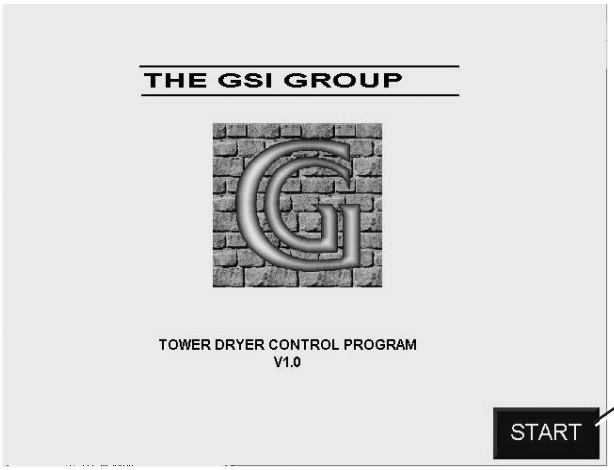
9. **Set drying / plenum temperature** by touching the P.L. Temp box on the LCD display. On the pop-up keypad that is displayed, enter the new drying temperature.

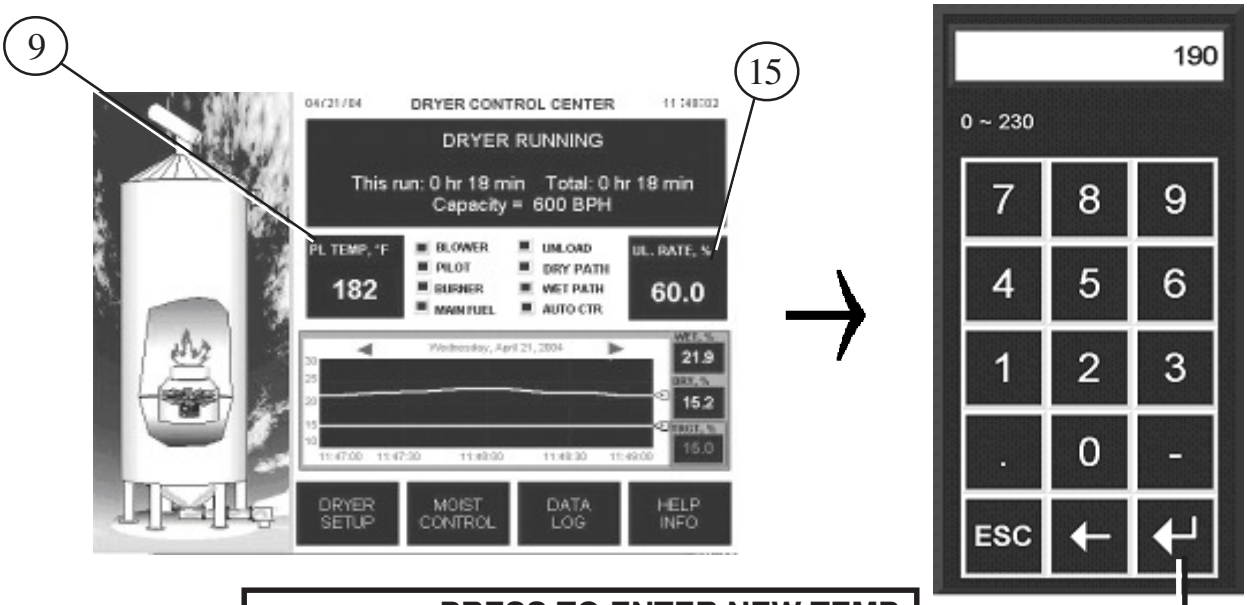
Recommended Drying Temperatures

Corn	180° to 210°F
Soybeans	140° to 160°F
Wheat	140° to 160°F
Milo	160° to 180°F
Barley	140° to 160°F
Oats	140° to 160°F

10. **Start the blower(s)** by turning the BLOWERS selector switch to the "ON" position. The blower(s) will automatically start. On multiblower units the PLC will automatically, start the blowers sequentially. Once the blower(s) are up to speed the airswitches will close and the blower switch light will illuminate.







NOTE: PRESS TO ENTER NEW TEMP. OR UNLOAD RATE

11. **Start the burner** by turning the BURNER selector switch to the "ON" position. The dryer automatically goes through a 30 second purge period once the blowers are started. The amount of time remaining on the purge cycle will be displayed on the LCD display screen. After the purge period the burner pilot will automatically light. Once the flame control circuit on the dryer senses flame, the light in the BURNER selector switch will illuminate. If the pilot fails to light in 15 seconds the burner will lock out and must be restarted by turning the BURNER switch "OFF" then back "ON".

12. **Cock and open the Maxon valves.** After the pilot is ignited, the main burner can be lit by cocking and opening the two Maxon gas shutoff valves. These valves will automatically open on dryers equipped with motorized Maxon Valves. The main burner will light and the dryer's plenum temperature will be automatically controlled by the modulating motor and maintained at the selected temperature.

12.1 **Open firing valve** (Canadian dryers only)

13. **Let plenum come up to temperature and begin drying**. Depending upon ambient conditions, the dryer may take 10 minutes or more to reach the drying temperature.

14. **Start unload system.** Before discharging grain from the dryer, first make sure all dry legs and conveyors are operating ahead of the dryer. Turn the UNLOAD CONVEYOR selector switch to the "ON" position to operate the dry grain conveyor leading from the dryer. Turn the METERING DEVICE selector switch to the "FORWARD" position to start discharging grain from the dryer.

⚠ The metering device will not run unless the unload conveyor is also running.

15. **Set Unload Rate/Moisture Control Temperature manually.** While operating the dryer in manual mode, set the unload rate by touching the U.L. Rate box on the LCD display. On the pop-up keypad, enter the new unload rate and press return.

16. **Check discharge moisture content** after 10 minutes. Take five small samples from the discharge and mix before taking a moisture reading.

17. **Switch over to Automatic Moisture Control.** When the discharge moisture content has stabilized at the desired amount for 20 to 30 minutes, the dryer may be switched over to Automatic Moisture Control.

17.1 Press the MOISTURE CONTROL button at the bottom of the LCD screen.

17.2 On the Moisture Control Setup screen, set the upper and lower limits by touching the corresponding box and using the pop-up keypad. These values prevent the unload from moving too fast or too slow should the incoming moisture be significantly greater or less than anticipated.

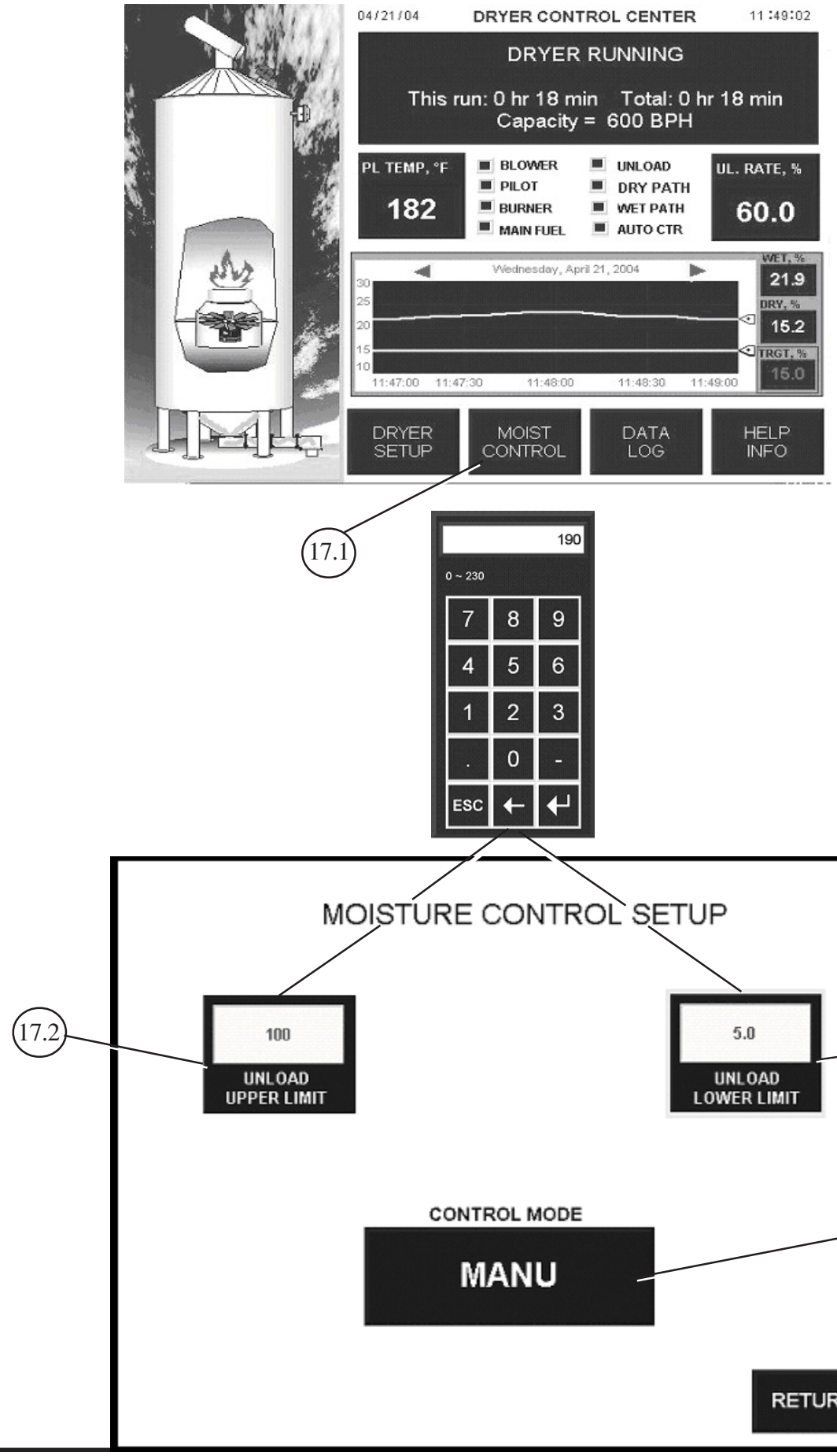
17.3 Press the CONTROL MODE box to toggle between Manual and Automatic moisture control. Note that the current and target grain tempertures are displayed next to the Temperature History Chart.

⚠ If the discharge moisture content is consistently too high or too low, adjust the target grain temperature as follows:

5°F increase = 1 moisture point decrease

5°F decrease = 1 moisture point increase

Allow 30 minutes between adjustments.


04/21/04
DRYER CONTROL CENTER
11:49:02
DRYER RUNNING
This run: 0 hr 18 min Total: 0 hr 18 min
Capacity = 600 BPH
PL TEMP, °F
182
BLOWER
PILOT
BURNER
MAIN FUEL
UNLOAD
DRY PATH
WET PATH
AUTO CTR
UL. RATE, %
60.0
Wednesday, April 21, 2004
WET, %
21.9
DRY, %
15.2
TRGT, %
15.0
30
25
20
15
10
11:47:00
11:47:30
11:48:00
11:48:30
11:49:00
DRYER SETUP
MOIST CONTROL
DATA LOG
HELP INFO
17.1
190
0 ~ 230
7 8 9
4 5 6
1 2 3
. 0 -
ESC
MOISTURE CONTROL SETUP
17.2
100
UNLOAD UPPER LIMIT
5.0
UNLOAD LOWER LIMIT
17.2
CONTROL MODE
MANU
17.3
RETURN

18. **Shutdown dryer.** The dryer will likely have to be shutdown from time to time. The steps used to shut it down will depend upon the duration of the shutdown. If the dryer will be shutdown for 4 hours or less, follow the Short Shutdown procedure. For longer shutdowns, such as overnight, follow the Extended Shutdown procedure

Short Shutdowns - Less than 4 hours

For short shutdown periods, the dryer can be shutdown by pushing the DRYER POWER STOP button. *To restart the dryer, push the DRYER POWER START button. The PLC will restart the dryer automatically based on selector switch settings.*

Extended Shutdowns - 4 hours or more

1. **Shut off the burner.** Turn the BURNER selector switch to the "OFF" position. All gas valves will immediately close and the burner will extinguish.

2. **Cool down grain.** PLC will continue to operate blowers to cool grain. To avoid overdried grain upon restarting the dryer, continue to move grain through the dryer during the cooling off period.

3. **Shut off unload equipment.** Turn METERING DEVICE and UNLOAD CONVEYOR selector switches to "OFF" position.

4. **Shut off blowers.** Turn BLOWER selector switch to "OFF" position.

5. **Shut off control panel.** Turn the CONTROL POWER selector switch to the "OFF" position.

6. **Turn off main circuit breaker** located on the power panel.

7. **Close main gas valve** to the dryer.

8. **Inspect the inside of the dryer** after operation to insure against the possibility of hot spots or fires.

Viewing Temperature/Moisture History

Press the left and right arrows above the Temperature/Moisture History Chart to move backward and forward through the graph.

Viewing Burner/Fuel Train Status

Press the Burner region in the Dryer View portion of the LCD display to switch to the Fuel Train Status screen. This screen displays the open/closed state of all valves as well as the modulating valve control value.

Viewing Grain Flow Status

Press the Unload region in the Dryer View portion of the LCD display to switch to the Grain Flow Status screen. This screen displays therunning status of all controlled/interlocked equipment in the grain flow path.

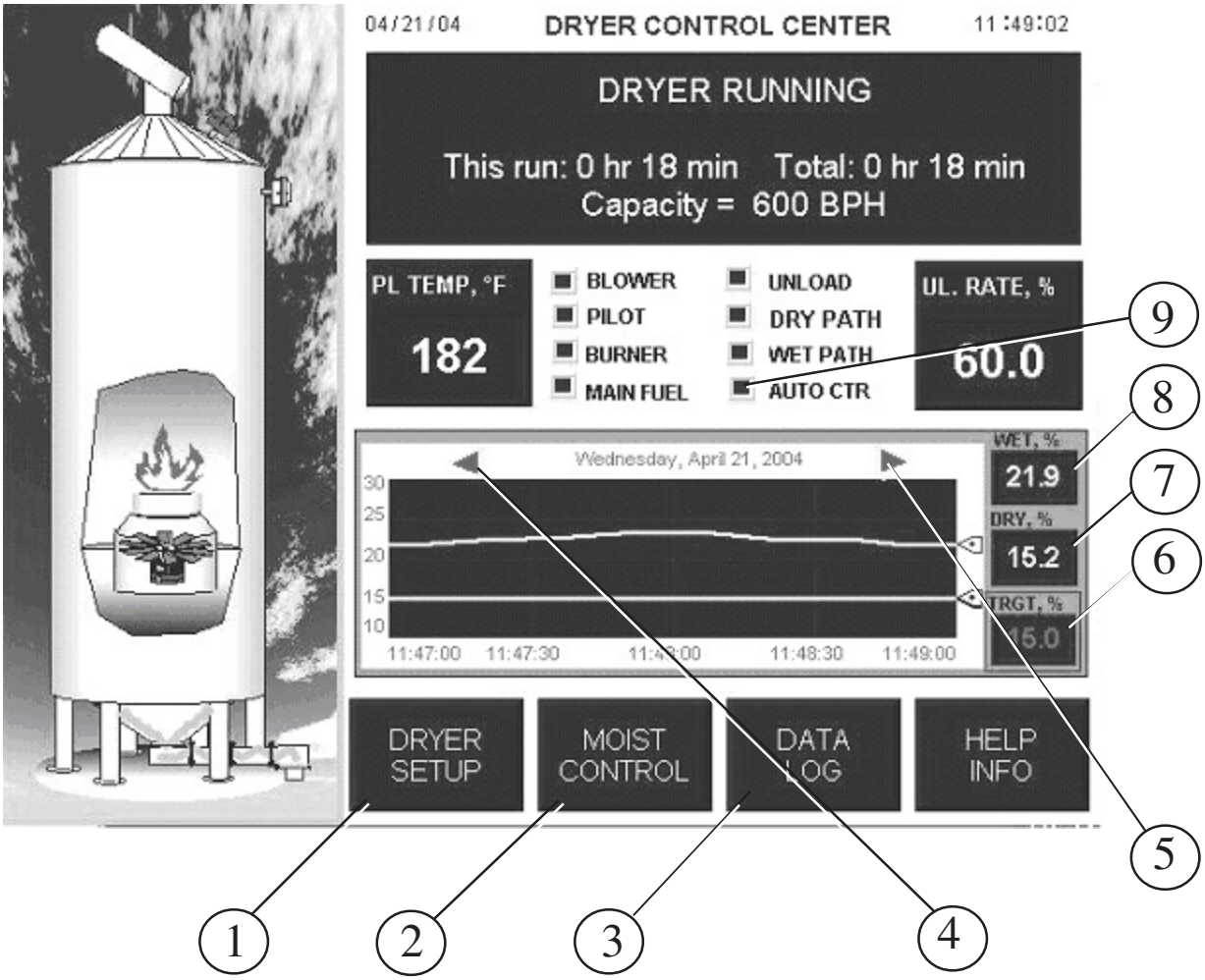
Modifying the Bushel Per Hour Factor

The bushel per hour reading given by the *PLC* is a calculated value based on metering device speed. Due to variations in grain test weight and unload system settings, the correction factor may need to be calibrated so that the calculated and actual grain flow rates agree. The bushel per hour factor is normally set at 1.0. If, for example, the actual grain flow rate is 5 percent higher than displayed, change the bushel per hour factor to 1.05. To adjust the correction factor, press the DRYER SETUP button, then the BUSHEL COUNTER button. Press the CORRECTION FACTOR box to adjust the value.

Optional Tri-Point Moisture Controller

Operation Manual

I. Main Screen



1. Two-hour moisture history chart - green line for incoming moisture; yellow line for outgoing moisture; and the red line is the target moisture.

2. Moisture Control button - to access the Moisture Control Set-up screen.

3. Data Log button - to access the moisture history data (up to last 30 hours).

4. Back browse button - to scroll the chart back in time.

5. Forward browse button - to scroll the chart in forward time

6. Moisture target - To change the moisture target, press within the rectangular area and key in the new target from the pop-up keypad.

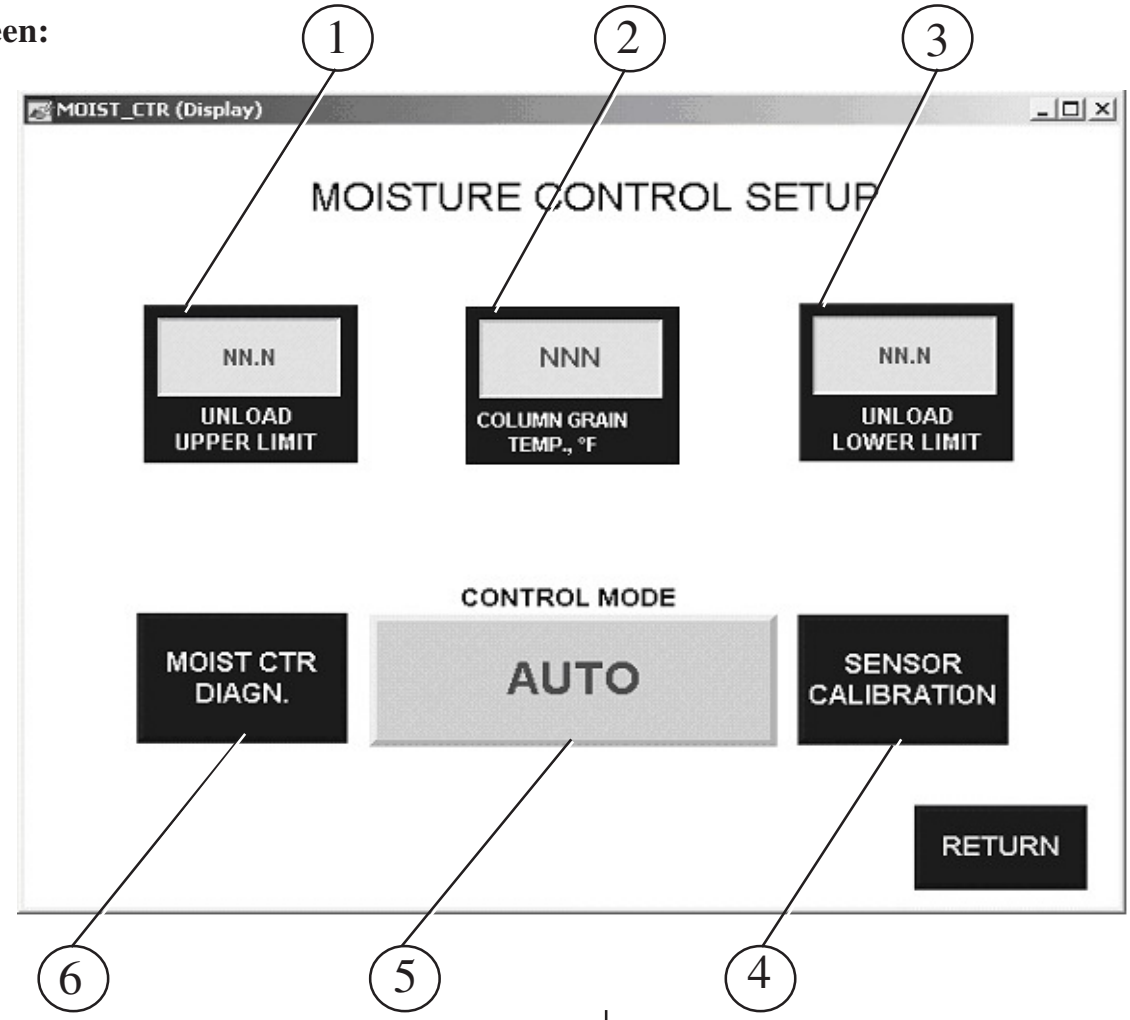
7. Current moisture coming out of the dryer.

8. Current moisture coming into the dryer.

9. Moisture control status - the LED turns on if the moisture controller is in auto mode

II. Set-Up of the Controller

***Press the "MOIST CONTROL" button from the main screen to access the moisture set-up screen:**



1. Unload upper limit - the maximum unloading rate (%) in which dryer can be run without plugging any unloading conveyors.

2. Current column grain temperature - measured from the RTD sensor at the end of the drying section (it is not the temperatureof the grain coming out of the dryer).

3. Unload lower limit - the minimum unloading speed that can maintain the sampling box of the dry sensor full of grain. It is essential to have the sensor fully covered by grain to get an accurate reading of the grain moisture.

4. Calibration button - to access sensor calibration screen (see Section III, Step 3).

5. Control Mode button - toggle the control mode between MANUAL and AUTO by pressing the button.

6. Moisture Control Diagnosis button - to access the diagnostic screen for factory trouble shooting.

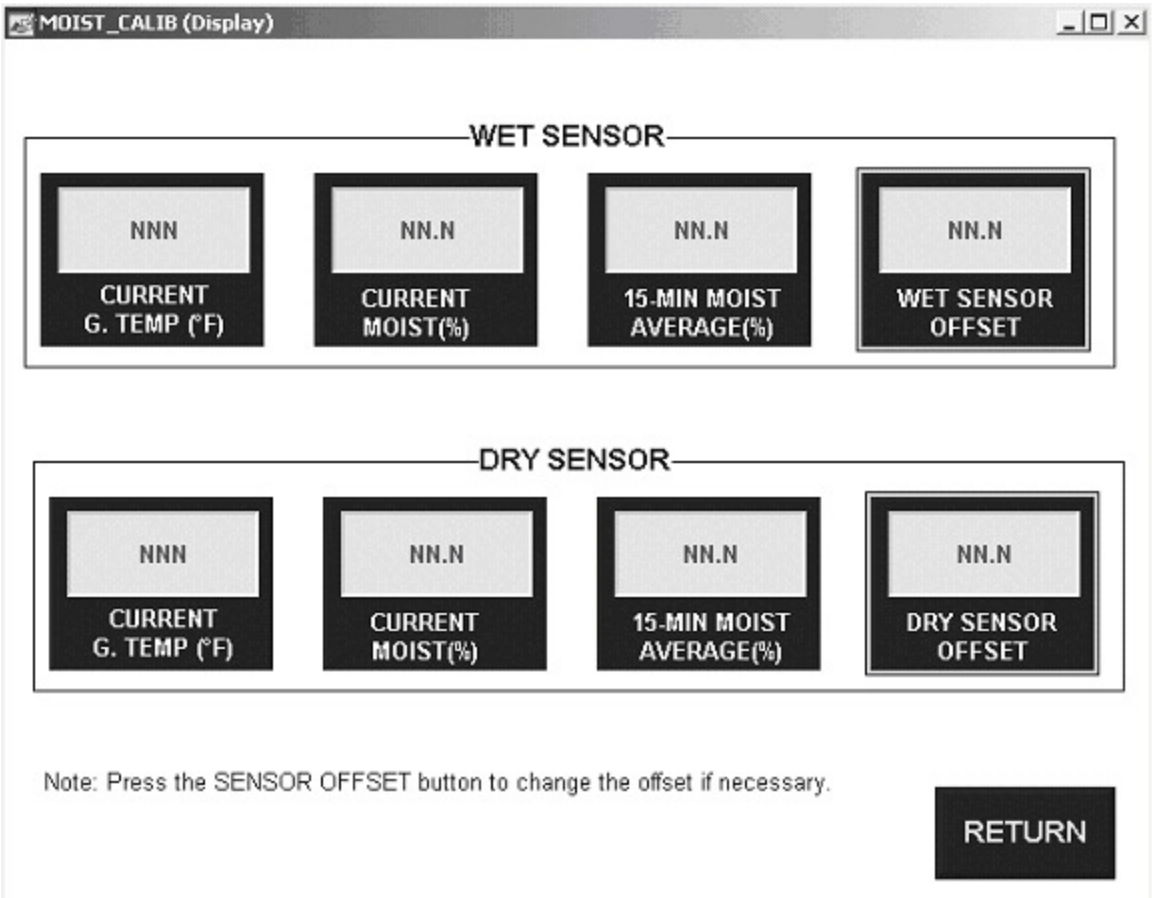
III. Operation Procedure

1. Start the dryer; set the dryer unload at a desired speed from the dryer control panel.
2. Let the dryer run under manual mode for warming up until the column grain temperature has stabilized and the moisture coming out of the dryer is within ± 2% of the target moisture.
3. During the start-up period, calibrate both the wet and dry sensors against a bench meter as follows:

a) Press "**SENSOR CALIBRATION"** button from the moisture control set-up screen to open the sensor calibration screen.

b) Take grain samples from the dryer, measure the moisture with a bench meter and then compare to the sensor reading during the sampling period.

Change the sensor offset if the sensor reading does not match the bench measurement. For example, if the offset was 1.0%, and the sensor reading is 0.5% lower than the bench meter, then change the offset to 1.5% to match the sensor to the bench meter. Likewise, if the sensor reading is higher than the bench meter, the offset should be decreased accordingly.



⚠ The sensor should be calibrated 2-3 times a day. At the same time check and clean the sensor and sensor sampling box to make sure that there is no debris blocking the grain flow around the sensor.

4. Check or change the target moisture from the main screen.

5. Press "**MOIST CONTROL**" to access the moisture control set-up screen. Check upper/lower unloading limits and change them if needed.

6. Press the "**CONTROL MODE**" button from the moisture control set-up screen and set the mode to **AUTO**. The moisture controller will start adjusting the unload rate between the upper and lower limits of the unload speed to maintain the moisture coming out of the dryer.

IV. How the Controller Works

The controller continuously monitors the moisture coming in and out of the dryer, and the column grain temperature at the end of the drying section. The control action is mainly based on the dry sensor at the outlet of the dryer. If the moisture coming out of the dryer is not right at the target, the controller will speed up or slow down the unload device accordingly. The wet sensor and the column grain temperature sensor are intended to detect moisture spikes coming into the dryer so that the moisture controller can react ahead of time. For example, if the wet sensor detects a jump of moisture coming into the dryer, the controller will start slowing down the unload speed right away. However, the controller does not act to the full scale immediately. Instead, it slows down the dryer gradually so that the grain currently in the dryer will not be overdried too much.

In the first pass after the dryer started, the controller does not have enough information of the grain in the dryer. It controls the dryer by using the manual speed setting as a starting point. In other words, the manual speed setting is most responsible for the first pass of drying. Therefore, set the manual unloading speed as close as it should be for the grain currently in the dryer before switching to **AUTO** control mode. The manual speed setting does not have to be adjusted after the controller is switched into **AUTO** mode.

V. Alarms

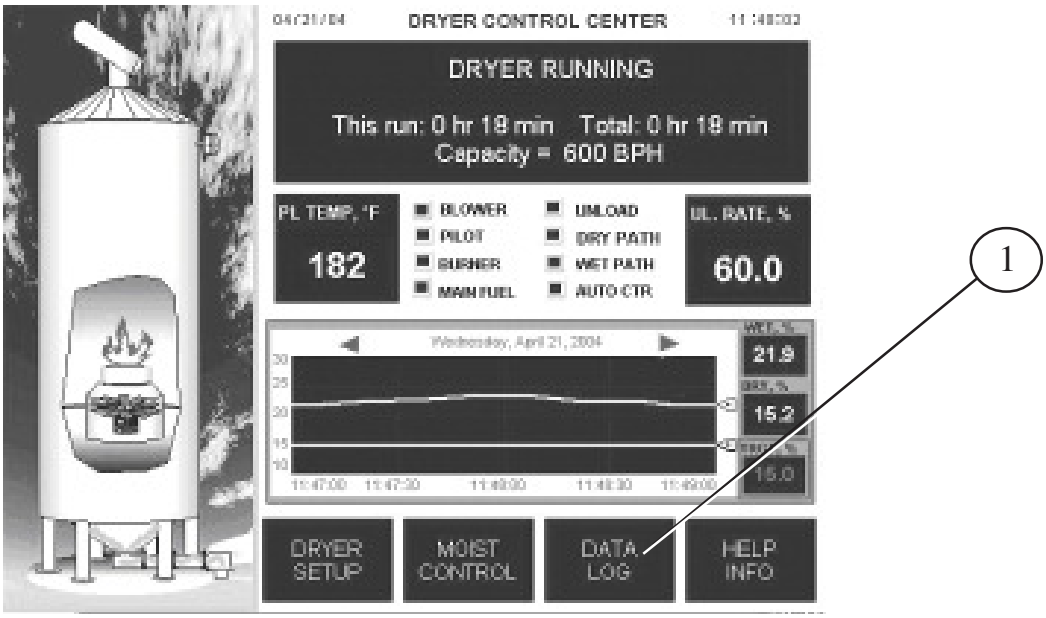
The controller checks the sensors and control status regularly. If abnormal conditions are detected, a corresponding alarm will go off, an alarm message will come up on the main screen **and the dryer will be shut down.**

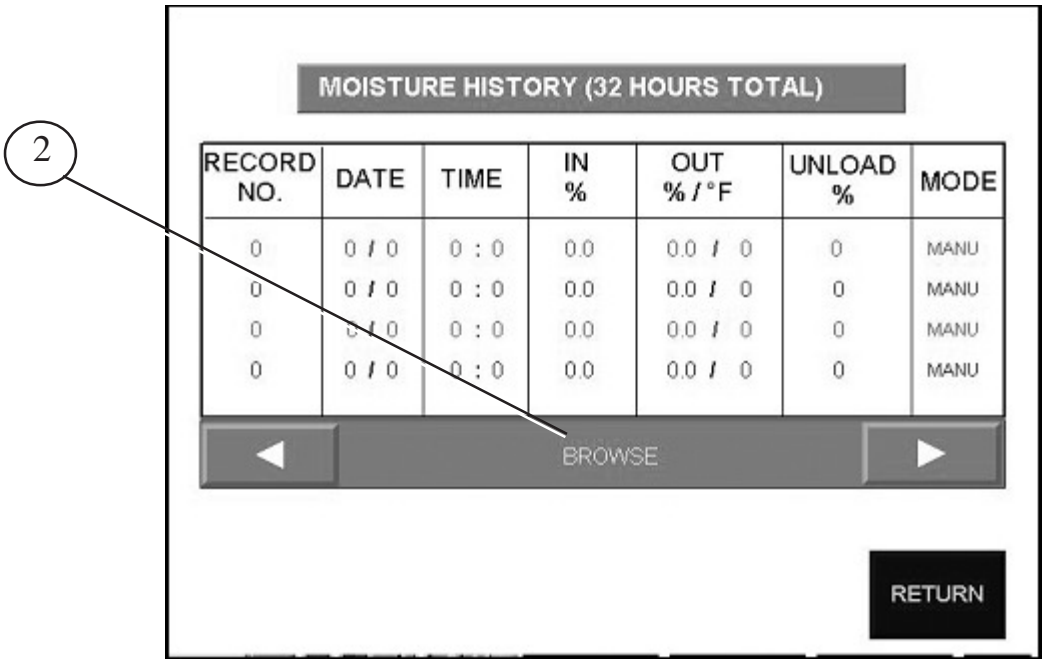
ALARM	CAUSES	SOLUTION
Moisture out of range - the moisture coming out of the dryer was 2.5% above or below the set-point for more than one hour under AUTO control mode	• Sensor box plugged and sensor was not covered by grain • Dry sensor out of calibration • Too big swing of moisture coming into the dryer	• Clear the sampler and sensor box • Calibrate the sensor • Run the dryer manually for one pass
Dry sensor error - sensor reading is less than 6% or higher than 40%	• Bad wiring • Bad sensor • Bad circuit board	• Check connection • Change the sensor • Change the circuit board
Dry grain temperature out of range (0-300F)	• Bad wiring • Bad sensor • Bad circuit board	• Check connection • Change the sensor • Change the circuit board
Wet sensor error - sensor readng is less than 6% or higher than 40%	• Bad wiring • Bad sensor • Bad circuit board	• Check connection • Change the sensor • Change the circuit board
Wet grain temp. out of range (0-300F)	• Bad wiring • Bad sensor • Bad circuit board	• Check connection • Change the sensor • Change the circuit board
Column grain temperature RTD out of range (0-300F)	• Bad wiring • Bad sensor • Bad circuit board	• Check connection • Change the sensor • Change the circuit board

VI. Access Drying History

1. Press the "**DATA LOG**" button from the main screen to open the moisture history screen. The controller logs quarterly data up to 120 records (i.e. 30 hours) into the archive.

2. Press the browse buttons to browse the record.





NOTES

NOTES

MAINTENANCE

PRE-SEASONAL INSPECTION AND SERVICE

The dryer is made of weather resistant material, and is designed to require minimum service. However, each season we recommend the following items be checked before the unit is used, and any damaged or questionable parts replaced. These checks will help eliminate possible failures, and assure dependable operation of the equipment.

1. Shut off electrical power. Open power box and control box, and inspect for moisture, rodent damage or accumulated foreign material present. Inspect and tighten any loose terminal connections. Replace any damaged or deteriorated wiring.

2. Lubricate the blowers, motors, and metering system as outlined in the Lubrication Table below.

3. Check blower belts for proper tension.

4. Inspect and clean the burner. Visually check that no holes in the stainless steel air mixing plates are plugged. If burner ports are plugged, clear them with a piece of wire or a drill bit. After a period of several years, it may become necessary to drill out the burner ports to clear away accumulated rust. Use a #43 drill bit to return burner ports to their original diameter. (See burner drilling procedure in the Maxon Burner area of the COMPONENT MANUALS section of this book.) (NOTE: Pre-2002 model dryers require a #47 drill bit.)

5. Check electrical connections at both the flame rod and spark plug. Clean spark ignitor and flame rod. Replace if necessary.

6. Check drain valve on gas train to insure that there is no water in the gas train. Valve should always be open when the dryer is not being used. Insure that drain valve is closed prior to dryer operation.

7. Lubricate linkage on gas modulating valve.

8. On **Zimmerman Dryers** equipped with the Accutrol sweep unload metering system, check the discharge area to insure that the area is cleaned of stalks and old grain. Inspect the sweeps for excessive wear.

9. On **GSI Dryers** equipped with the hoppered metering system, check the hopper area and the area around the metering drum to insure that they are cleaned of stalks and old grain. Check the edges of the metering drum for excessive wear.

10. Important!! The covers to the discharge sections on both the Zimmerman and GSI Tower dryers must be in place and clamped down at all times when the dryer is in operation. If the cover is off during operation, the vacuum created by the blowers will suck foreign matter from the discharge area and deposit it in the heat section of the dryer plugging the inside screens of the dryer also creating a fire hazzard.

SEE PRE-SEASON CHECKLIST AT THE END OF THIS SECTION

SEASONAL INSPECTION AND SERVICE

1. **Important!** The covers to the metering system access door(s) must be in place at all times when the dryer is in operation. Before turning blowers always make sure this door is clamped into position.

2. Follow lubrication guides as outlined in the Lubrication Table.

3. **Do not let grain fines and dust accumulate inside the cooling section of the dryer.** Bi-weekly if drying most products or daily if drying milo, clean the cooling chamber floor of fines and dust. Sweep down the cooling section sheets if necessary. Fines can be swept into the unload systems on both the Zimmerman and GSI dryers.

4. **Do not let grain fines and dust accumulate inside the heat section of the dryer.** Daily check the hopper divider that separates the heat section from the cooling section to insure that it remains clean and open.

5. When cleaning dryer, check the grain discharge area on the dryer. On **GSI** hopper bottom dryers check around the metering drum to insure that grain is flowing freely from each column and that there is no trash build-up. On **Zimmerman** Accutrol sweep dryers check the sweeps for trash or stalk buildups that could be obstructing grain flow.

6. If undried grain is left in the dryer for more than a week during the drying season, inspect the plenum roof to make sure that there is no wet grain sticking to the roof that could restrict grain flow. When the dryer is restarted make sure that all grain columns are evenly unloading.

7. When drying dirty corn in high humidity conditions, sludge may build up in the upper outside sheets of the dryer. This build up can be removed by either washing the sheets down with a high pressure water hose, or by shutting incoming grain, dropping the grain level to below the plugged area, and then running the fans and burner to dry the affected area. Tapping or sweeping the sheets will dislodge debris. Attempting to sweep off the sheet build-up while it is still wet will usually plug the sheet more.

IN CASE OF FIRE

1. When you first detect a fire, the entire drying operation should be shut down, including grain flow into and out of the dryer. The emergency controls may have already done this. Also, shut off the electrical and fuel supply to the dryer.

2. Do not try to cool a fire by running fan(s).

3. Never run grain from the dryer into the elevator or storage if a fire is known or suspected.

4. Locate the area of the fire.

5. If the fire can be extinguished with a fire extinguisher, water hose or by removing the burning material, this should be done right away. Watch the dryer closely for another fire after one has occurred.

6. Emergency discharge slide gates at the bottom of each column as well as easy access gates located near the hopper discharge area permit fast dumping of each individual grain column.

7. A fire extinguisher should be located at or near the dryer, if a fire seems to be getting out of control call the fire department.

END OF SEASON SERVICE

1. Empty the dryer at the end of the drying season. The dryer should not be used for grain storage. Grain left in there for an extended period of time can become wet, swell and spoil. Chunks of spoiled grain can plug the metering system and swelled grain places undue stress on the interior and exterior sheeting of the dryer.

2. Clean out the plenum roof grain cushion and remove any grain that may be hanging up on the plenum roof.

3. Make sure the grain exchangers are clean.

4. Clean out the hopper that divides the heat section from the cooling section.

5. Clean the cooling chamber floor.

6. Remove all grain and trash from the metering drum floor. This grain can be raked out by hand by opening the slide gates located in the hopper bottom of the dryer.

7. Make sure gas supply is shut off to the dryer.

8. Open the gas train drain valve located on the bottom of the gas train.

9. It is a good practice to cover the burner with a tarpaulin or plastic to insure a clean burner.

LUBRICATION TABLE

LOCATION	INSTRUCTIONS	TYPE OF LUBRICATION	LUBRICATION INTERVAL
Metering drum drive shaft bearing **(On GSI hopper bottom dryers only).**	Lubricate slowly until lube shows through seal. Wipe clean.	High quality; grade #2 lithium based grease.	Beginning of season (annually).
Accutrol (sweep unload) top and bottom drive bearings. **(On Zimmerman flat bottom dryers only).**	Lubricate slowly until lube shows through seal. Wipe clean.	High quality; grade #2 lithium based grease.	Beginning of season (annually).
Accutrol (sweep unload) coupling hub. **(On Zimmerman Dryers).**	Remove the two lube plugs from the cover. Lubricate slowly until grease begins seeping through relief plug.	High quality; grade #2 lithium based grease.	Beginning of season (annually).
Blower shaft bearings. **(Both GSI and Zimmerman Dryers).**	Lubricate bottom bearing plug slowly counting the grease gun pump until lube shows through the seal. Wipe clean. Use same # of grease gun pumps for top bearing.	High quality, grade #2 lithium based grease.	Every 4 weeks of dryer operation.
Blower motor bearings **(Both GSI and Zimmerman Dryers)**	See motor lubrication procedure below[1]	High quality, grade #2 lithium based grease	Every 2 years (Normal operation, ever 8-10 months continuous operation).
Metering variable speed drive motor **(Both GSI and Zimmerman Dryers)**	See motor lubrication procedure below[1]	High quality, grade #2 lithium based grease	Every 2 years (Normal operation, ever 8-10 months continuous operation).
12' Diameter Accutrol gearbox (12' diameter sweep unload gearbox) **(Zimmerman Dryers only)**	Grease filled gearbox. Replenish grease to the first 1st stage (upper) reduction mechanism through grease fitting provided (typically quantity= 0.3 oz. of grease	High quality, grade #2 lithium based grease	Beginning of season (annually). (Change grease in box every 3-5 years)
18' & 24' Diameter Accutrol gearbox (18' and 24' diameter sweep unload gearbox **Zimmerman Dryers only).**	Oil filled gearbox w/ oil pump. Maintain oil level to upper red line on oil level gauge.	ISO VG 100 to 150 mineral-based oil. AGMA Viscosity Grade 3EP to 4EP. (Mobilgear 627, 629 or equivalent).	Beginning of season. (Change every 2 years).
Metering drum gearbox. **(On GSI hopper bottom dryers only)**	Fill to check plug.	ISO VG 220 mineral-based oil. AGMA Viscos-ity Grade 5EP. (Mobilgear 630 or equivalent).	Beginning of season. (Change every 10,000 hours or 2 years).

[1]**Lubrication of motors** - Operate motor for 20 minutes. Clean grease fitting. Remove grease relief plug and using a low pressure grease gun, pump in the required grease. After relubricating, allow motor to run for 10 minutes before replacing relief hardware. ***Do NOT overgrease!***

PRE-SEASON SERVICE CHECKLIST

_____ Lubricate blower bearings.

_____ Lubricate blower motor bearings, if needed.

_____ Check blower belts and adjust if necessary.

_____ Clean burner ports.

_____ Inspect flame rod and spark ignitor.

_____ Check oil levels in gearboxes.

_____ Inspect divider hopper between heat and cooling section. Clean if necessary.

_____ Inspect Bindicator grain level switches.

_____ Inspect metering system access door cover seals.

_____ Lube metering system access door cover hold down latches.

_____ Lube Modutrol motor linkage.

_____ Check butterfly operation in modulating valve.

_____ Check gas pressure gauges.

_____ Check interior of Maxon shutoff valves for corrosion. Clean if necessary.

_____ Clean control and power panels, tighten loose connections, and check for leaks.

_____ Inspect metering systems. Clean accumulated stalks and old grain.

_____ Start up dryer and check operating controls.

_____ Other: Itemize_____

END OF SEASON SHUT-DOWN PROCEDURE

_____ Start unload and and empty all grain from dryers.

_____ Clean out grain cushion (on plenum roof under fill spout). Clean plenum roof.

_____ Clean off grain exchangers.

_____ Clean out divider hopper, between heating and cooling section.

_____ Clean inside cooling sheets and cooling floor.

_____ Remove all grain and trash from unload section of dryer.

_____ Open emergency grain discharge doors (and drain doors in Zimmerman dryers).

_____ Open drain valve in gas train.

_____ Cover burner with a tarp or plastic sheeting.

TROUBLE SHOOTING

The GSI & Zimmerman Tower dryers are designed to be self diagnosing. Most electrical or operating problems are displayed on the screen of the operator interface and the problem area is graphically high lighted. Always insure that either 240 or 480 volt 3 phase power is being provided to the dryer. All motor starters coils and the burner circuitry operate at 120v AC. All of the safety circuit on the dryer operates at 24v DC.

Listed below are potential trouble shooting issues associated with the dryer and possible solutions to the problems.

TROUBLESHOOTING – DRYING ISSUES

Problem	What to do
Low dryer capacity.	- Check to make sure the dryer is always full of grain. - Check all grain columns to make sure they are all moving. - Check outside dryer screen for dirt build up. Clean if necessary.
Grain moisture discharges too wet.	- Reduce unload rate. - Or increase drying temperature.
Grain moisture discharges too dry.	- Increase unload rate. - Or decrease drying temperature.
Grain moisture discharges inconsistently.	- Check that plenum temperature is being held consistent. - Check for widely varying incoming moistures. - Check for plugged grain columns. - Verify that an adequate supply of grain is being provided to the dryer to maintain a grain seal within the dryer.
Burnt or scorched kernels appear during drying.	- Some varieties of grain or frost damaged grain are sensitive to higher drying temperatures. Lower drying temperatures. - If dryer is equipped with an external LP vaporizer, insure that liquid propane is not passing through the vaporizer and going to the dryer.
Grain not moving through grain columns.	- Check the dryer for fines build up within the column. Empty if necessary. - Do not leave the dryer full for extended periods of time or during rainy weather without occasionally moving grain through it.

TROUBLESHOOTING – BURNER

Problem	What to do
Pilot will not light.	- Check to see that the gas shutoff valve is open. - Verify that gas is being provided to the dryer by checking the presure gauge located in the pilot line. - Verify that the pilot solenoid is opening by listening for a “clicking” sound. - Remove the pilot line from the pilot solenoid with the dryer turned off to verify that no water is in the pilot line. Blow the pilot line out with compressed air. - Before reattaching the pilot line attempt to light the pilot with the line removed. Gas should be flowing from the pilot solenoid. - If gas is flowing, reattach the pilot line and adjust of flow of gas by adjusting the pilot regulator.

Problem	What to do
Pilot will not light. (Continued)	- If pilot still doesn't light, check pilot area on burner. Clean if necessary. - If pilot area is hot indicating that the pilot was lighting, replace flame rod. - If pilot area is cold, replace spark plug. - If pilot still doesn't light, check the Protectofier components in the control box.
Pilot lights but main burner will not light	- Check for water in gas train by opening drain valve. - Maxon valve should offer some resistance when opening. If it doesn't, check latching solenoid inside Maxon valve. - Check for broken or bent butterfly valve. - Check to make sure burner ports around the pilot are clean.
Dryer will not reach operating temperature.	- Increase gas pressure on main gas regulator. - Make sure dryer is completely full of grain. - Gas ports on burner need to be drilled. Clean by using a #43 drill bit. - Check to make sure butterfly valve is fully opening. - Check for water in gas train by opening drain valve.
Plenum temperature fluctuates.	- Gas pressure is to high. Lower gas pressure on main gas regulator.
Dryer loses flame at regular intervals while running.	- Loose or dirty flame rod. Clean and/or tighten. - Defective Protectofier SS3CP transformer in control box. Replace.
Modulating Valve does not open.	- Check to see that Maxon shutoff valves are open. - Check to see that the plenum setpoint temperature is higher than the ambient temperature. - Check to see that 120VAC is being provided to the black and white wires in the modutrol motor. - Check the operation of the modutrol motor be momentary jumping the "F" and "-" terminals in the motor to see if the motor will open.

TROUBLESHOOTING – GENERAL

Problem	What to do
Control power switch will not light.	- Check to see that main circuit breaker in power box is on. - Check fuses "F1", "F2", "F3" in power box. - Check circuit breaker "CB-04" in power box. - Check MicroLogix PLC in control box.
OIU fails to light.	- Check to see that main circuit breaker in power box is on. - Check fuses "F1", "F2", "F3" in power box. - Check circuit breaker "CB-04" in power box.
Dryer shuts down, red light lights and horn sounds, display shows: "OVERHEAT AT PLENUM" "POSSIBLE FIRE"	- Check for possible fire in heat section of dryer. - Make sure the plenum high limit control is set at least 30° above the desired drying temperature. - Check for a malfunctioning gas train component that could be causing excessive plenum temperatures.

Problem	What to do
Dryer shuts down, red light lights and horn sounds, display shows: "OVERHEAT AT _____" "POSSIBLE FIRE"	- Check for possible fire in dryer at location indicated in message. - Check for a plugged or slow moving grain column. - Check for a plugged grain turner. - Check to insure that the dryer is full of grain and is continually being kept full. - Check for a defective high limit sensor.
OIU displays message: "UNLOAD DRIVE FAULT"	- Indicates that the metering system inverter drive has tripped. - Check for plugged metering drum or Accutrol metering system. - Reset drive by turning off the main circuit breaker for 15 seconds, or by pressing the "STOP" button on the inverter.
OIU displays message: "CONTACT FAILED TO CLOSE" "DRY CONVEYOR" -or- "WET CONVEYOR" -or- any auxiliary starter	- Indicates that any overload has occurred in the item indicated. - Reset the overload of the starter indicated in the power panel and fix the overloaded conditions.
OIU displays message: "OVERLOAD TRIPPED" "BLOWER __ STARTER"	- Indicates that overload has occurred in the blower indicated. - Reset the overload of the starter of the blower indicated and fix the overload conditions. - Blower overload can be caused by overly tightened blower belts or inadequately greased blower bearings.

TROUBLESHOOTING – OIU (SCREEN) MESSAGES

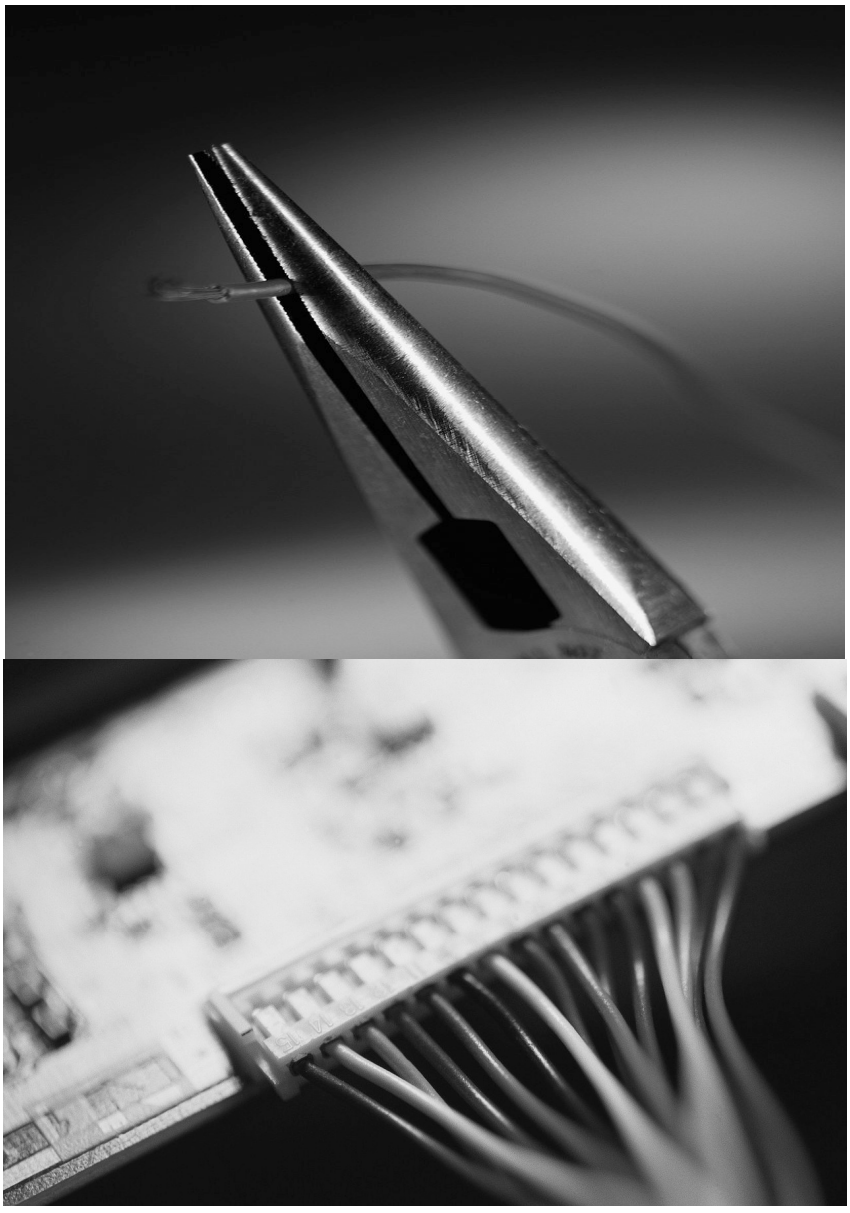
Message	What to do
LOST COMM. TO MICRO	Cycle the power
OVERHEAT AT TOP LEFT POSSIBLE FIRE!!!	Check overheat condition and Term. 101
OVERHEAT AT TOP RIGHT POSSIBLE FIRE!!!	Check overheat condition and Term. 102
OVERHEAT AT MID. LEFT POSSIBLE FIRE!!!	Check overheat condition and Term. 103
OVERHEAT AT MID. RIGHT POSSIBLE FIRE!!!	Check overheat condition and Term. 104
OVERHEAT AT LOWER LEFT POSSIBLE FIRE!!!	Check overheat condition and Term. 105
OVERHEAT AT LOWER RIGHT POSSIBLE FIRE!!!	Check overheat condition and Term. 106
OVERHEAT AT INSIDE LEFT POSSIBLE FIRE!!!	Check overheat condition and Term. 107
OVERHEAT AT INSIDE RIGHT POSSIBLE FIRE!!!	Check overheat condition and Term. 108
OVERHEAT AT PLENUM POSSIBLE FIRE!!!	Check overheat condition and Term. 109
OVERLOAD TRIPPED TRI-STARTER	Check Term. 300
OVERLOAD TRIPPED BLOWER 1 STARTER	Check Term. 301
OVERLOAD TRIPPED BLOWER 2 STARTER	Check Term. 302
OVERLOAD TRIPPED BLOWER 3 STARTER	Check Term. 303
OVERLOAD TRIPPED BLOWER 4 STARTER	Check Term. 304
AUXILIARY STUCK CLOSED TRI-STARTER	Check Term. 200
AUXILIARY STUCK CLOSED BLOWER 1 STARTER	Check Term. 201
AUXILIARY STUCK CLOSED BLOWER 2 STARTER	Check Term. 202

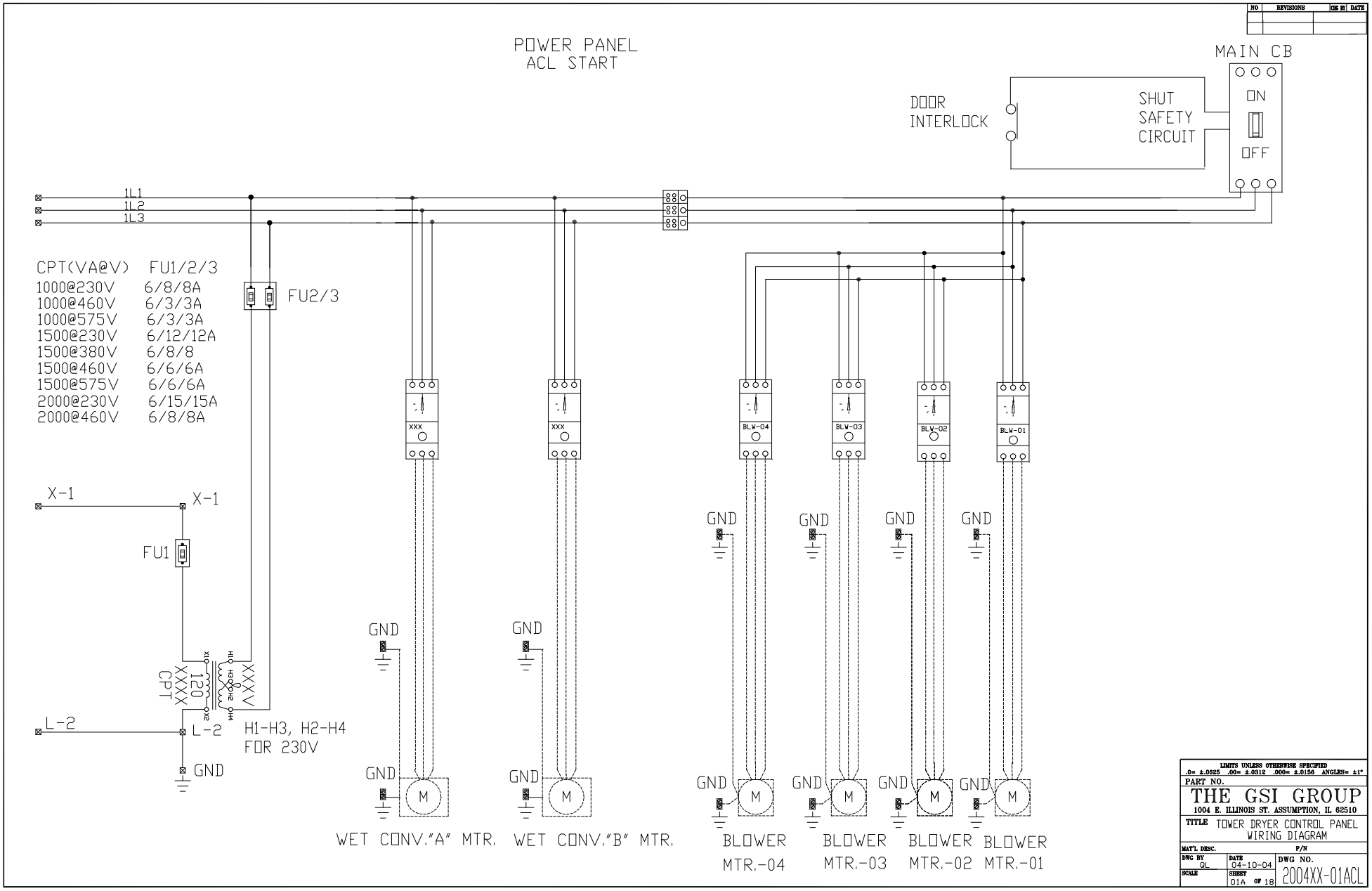
Message	What to do
AUXILIARY STUCK CLOSED BLOWER 3 STARTER	Check Term 203
AUXILIARY STUCK CLOSED BLOWER 4 STARTER	Check Term. 204
AUX. CONTACT FAILED TO CLOSE TRI-STARTER	Check Term. 200
AUX. CONTACT FAILED TO CLOSE BLOWER 1 STARTER	Check Term. 201
AUX. CONTACT FAILED TO CLOSE BLOWER 2 STARTER	Check Term. 202
AUX. CONTACT FAILED TO CLOSE BLOWER 3 STARTER	Check Term. 203
AUX. CONTACT FAILED TO CLOSE BLOWER 4 STARTER	Check Term. 204
SWITCH OPEN AIR PRESSURE SWITCH 1	Check Term. 205
SWITCH OPEN AIR PRESSURE SWITCH 2	Check Term. 206
SWITCH OPEN AIR PRESSURE SWITCH 3	Check Term. 207
SWITCH OPEN AIR PRESSURE SWITCH 4	Check Term. 306
SWITCH OPEN AIR PRESSURE SWITCH OF COMBUSTION BLOWER	Check Term. 115
LOST FLAME	Check BCU and Term. 114
SWITCH STUCK CLOSED MAXON VALVE	Check Term. 113
FLAME DETECTED WHILE BURNER IS OFF	Check if pilot or Maxon valves stuck open and check flame rod, BCU and Term. 114
HI. GAS PRESSURE SWITCH OPEN	Check Term. 111
LOW GAS PRESSURE SWITCH OPEN MAKE SURE MAIN GAS VALVE IS ON	Check gas pressure and Term. 110
HI. GAS PRESSURE SWITCH OPEN GAS PRESSURE TOO HIGH	Check Term. 111
LOW GAS PRESSURE SWITCH OPEN GAS PRESSURE TOO LOW	Check Term. 110
MAXON VALVES NOT TURN ON	Reset and try again
PL. TEMPERATUR RTD CIRCUIT OPEN OR SHORTED	Check the RTD wiring
GRAIN TEMPERATUR RTD CIRCUIT OPEN OR SHORTED	Check the RTD wiring
AUXILIARY STUCK CLOSED OIL PUMP STARTER	Check Term. 307
AUXILIARY STUCK CLOSED COMBUSTION BLOWER STARTER	Check Term. 308
AUX. CONTACT FAILED TO CLOSE OIL PUMP STARTER	Check Term. 307
AUX. CONTACT FAILED TO CLOSE COMBUSTION BLOWER STARTER	Check Term. 308
PLUG SWITCH OPEN DRY PATH PLUGGED	Clear dry path and check Term. 309
PLUG SWITCH OPEN HOPPER PLUGGED	Clear hopper and check Term. 310
UNLOAD DRIVE FAULT	Check the drive and Term. 208
OVERLOAD TRIPPED DRY CONVEYOR	Check Term. 305
PLUG SWITCH OPEN WET PATH PLUGGED	Clear wet path and check Term. 311
AUXILIARY STUCK CLOSED DRY CONVEYOR	Check Term. 209
AUXILIARY STUCK CLOSED AUX. DRY CONVEYOR	Check Term. 210
AUXILIARY STUCK CLOSED DRY LEG	Check Term. 211
AUXILIARY STUCK CLOSED TOP DRY CONVEYOR	Check Term. 212
UNLOAD MONITOR PROXIMITY SWITCH OPEN	Check the unload device and Term. 313
AUXILIARY STUCK CLOSED AUX. WET CONVEYOR	Check Term. 215
AUXILIARY STUCK CLOSED WET LEG	Check Term. 214

Message	What to do
AUXILIARY STUCK CLOSED TOP WET CONVEYOR	Check Term. 213
CONTACT FAILED TO CLOSE DRY CONVEYOR	Check Term. 209
CONTACT FAILED TO CLOSE AUX. DRY CONVEYOR	Check Term. 210
CONTACT FAILED TO CLOSE DRY LEG	Check Term. 211
CONTACT FAILED TO CLOSE TOP DRY CONVEYOR	Check Term. 212
CONTACT FAILED TO CLOSE AUX. WET CONVEYOR	Check Term. 215
CONTACT FAILED TO CLOSE WET LEG	Check Term. 214
CONTACT FAILED TO CLOSE TOP WET CONVEYOR	Check Term. 213
BINDICATOR ERROR UBS closed while LBS still open	Check Term. 314 & 315
SHUT DOWN OUT OF GRAIN Occurred at ——	
DRY SENSOR ERROR MOISTURE SIGNAL OUT OF RANGE	Check the sensor wiring
DRY SENSOR ERROR GRAIN TEMP. SIGNAL OUT OF RANGE	Check the sensor wiring
WET SENSOR ERROR MOISTURE SIGNAL OUT OF RANGE	Check the sensor wiring
WET SENSOR ERROR GRAIN TEMP. SIGNAL OUT OF RANGE	Check the sensor wiring
COLUMN GRAIN RTD SENSOR ERROR RTD OUT OF RANGE	Check the sensor wiring
SHUT DOWN BY MOISTURE CONTROLLER FAILED TO MAINTAIN TO THE TARGET	Try again w/ close supervision
READY TO START	Press the dryer control START
READY TO START BLOWER	Turn blower switch to ON to start
READY TO START BURNER	Turn burner switch to ON to start
OUT OF GRAIN	Will shut down in ___ seconds
START UNLOAD NOW	Or will shut down ___ seconds
DRYER COOLING OFF Current grain temp. = ____	Blower will shut down in ____ secs/*N:5 or turn the blower switch off to shut down now.
WET PATH NOT ON	Turn load switch to MAN or AUTO to start
FILLING THE DRYER	Please wait...
DRYER IS FULL	Press control STOP button to reset alarm Then press control START button to restart
EMPTYING THE DRYER	Please wait...
NO POWER TO SLC	Pull E-STOP button out and check Term 100 for 24VDC
START CHECKING Please wait ___ seconds left TRI-START ON ___ seconds left STARTING BLOWER 1 STARTING BLOWER 2 STARTING BLOWER 3 STARTING BLOWER 4 PURGING ____ seconds left OPEN MAIN FUEL VALVES or will shut down in ____ seconds IGNITION TRIAL ____ seconds left	
FIRING VALVE LIMIT SWITCH OPEN OPEN THE FIRING VALVE INTERLOCKED START DRY CONVEYOR FIRST INTERLOCKED START AUX. DRY CONVEYOR FIRST INTERLOCKED START DRY LEG FIRST	Check Term. 112

Message	What to do
INTERLOCKED START TOP DRY CONVEYOR FIRST INTERLOCKED START AUX. WET CONVEYOR FIRST INTERLOCKED START WET LEG FIRST INTERLOCKED START TOP WET CONVEYOR FIRST	Check Term. 112

ELECTRICAL DIAGRAMS

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POWER PANEL
ACL START
MAIN CB
ON
OFF
DOOR
INTERLOCK
SHUT
SAFETY
CIRCUIT
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1L2
1L3
CPT(VA@V) FU1/2/3
1000@230V 6/8/8A
1000@460V 6/3/3A
1000@575V 6/3/3A
1500@230V 6/12/12A
1500@380V 6/8/8
1500@460V 6/6/6A
1500@575V 6/6/6A
2000@230V 6/15/15A
2000@460V 6/8/8A
FU2/3
X-1
X-1
FU1
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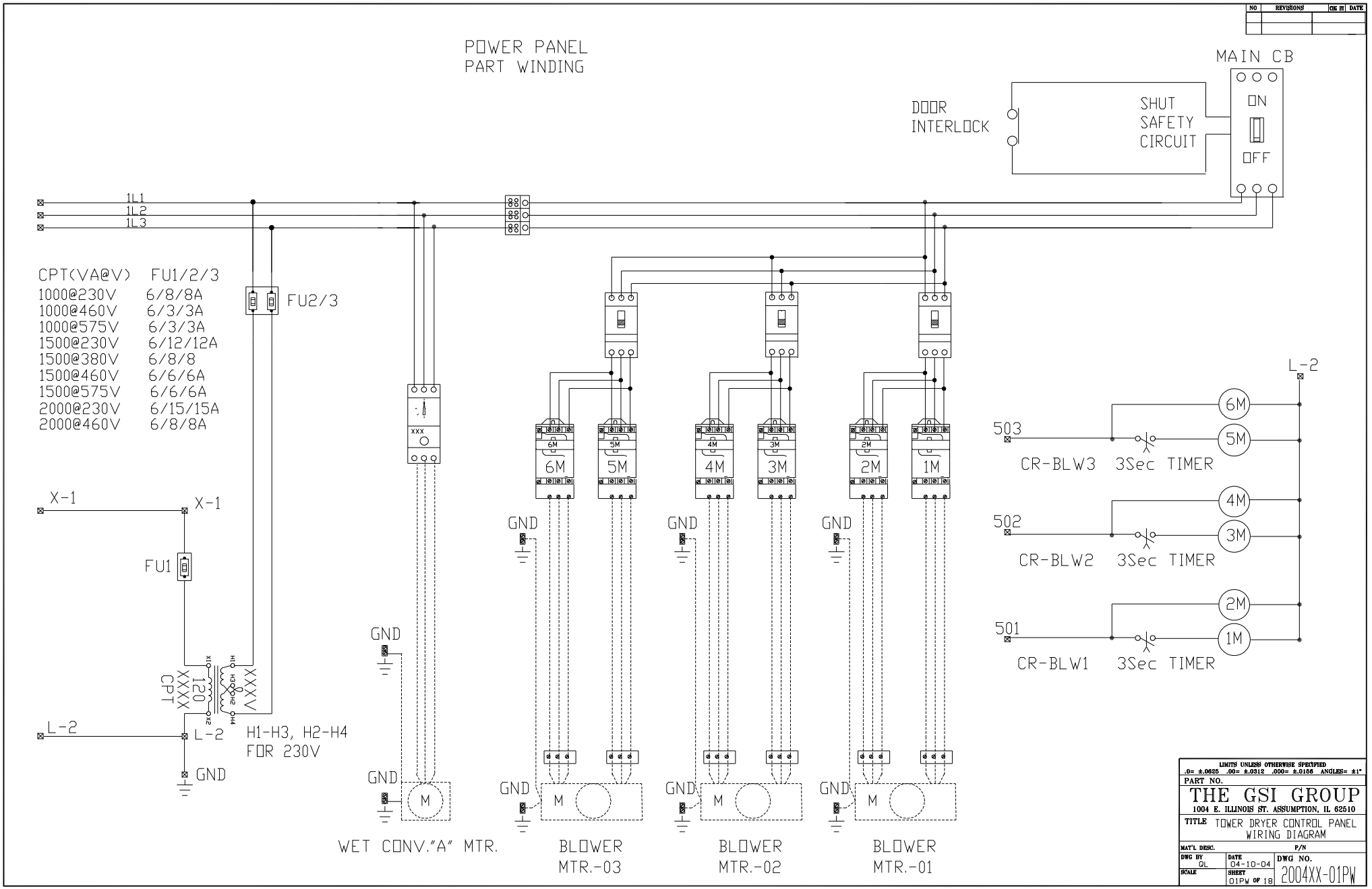
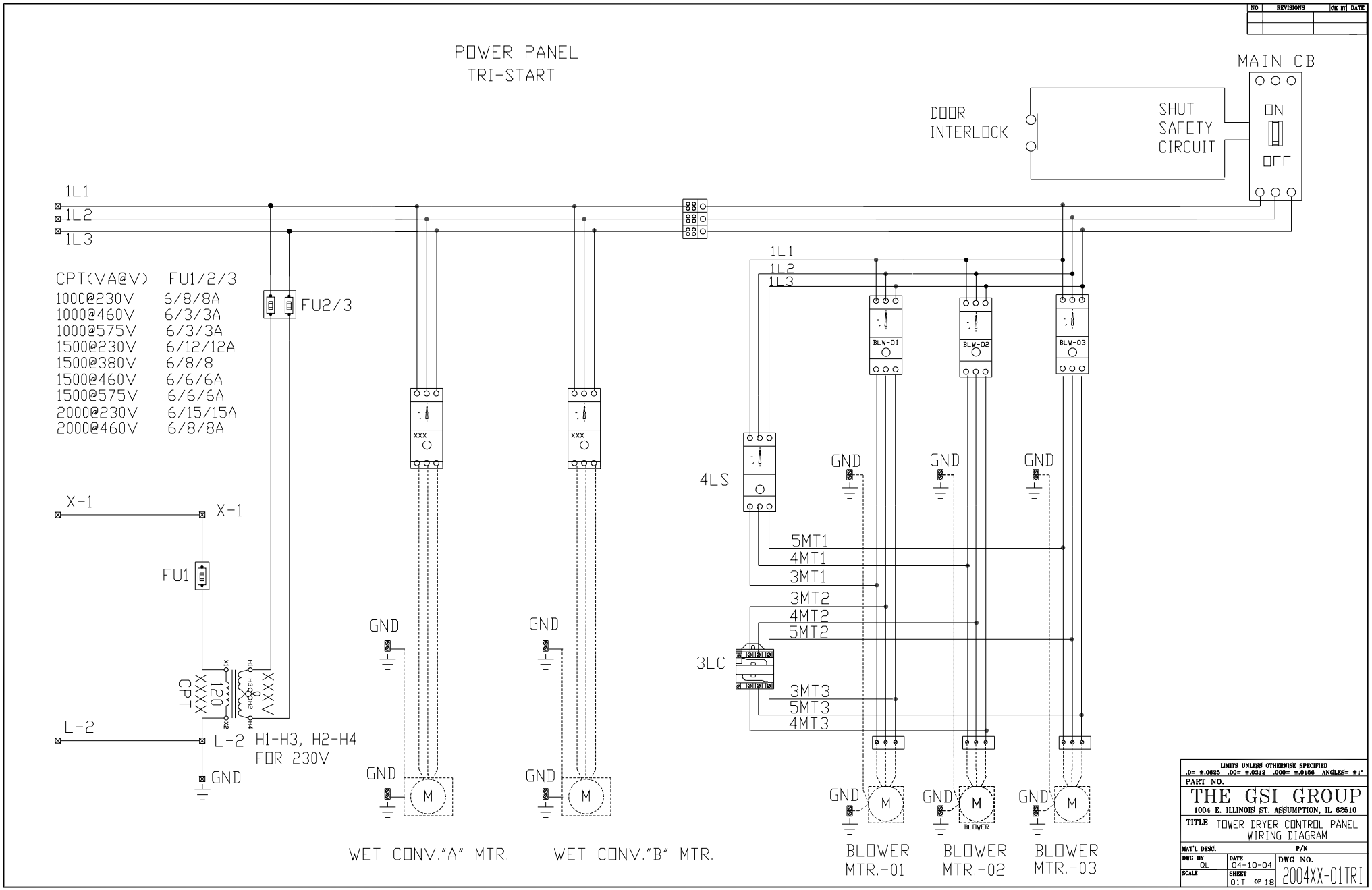
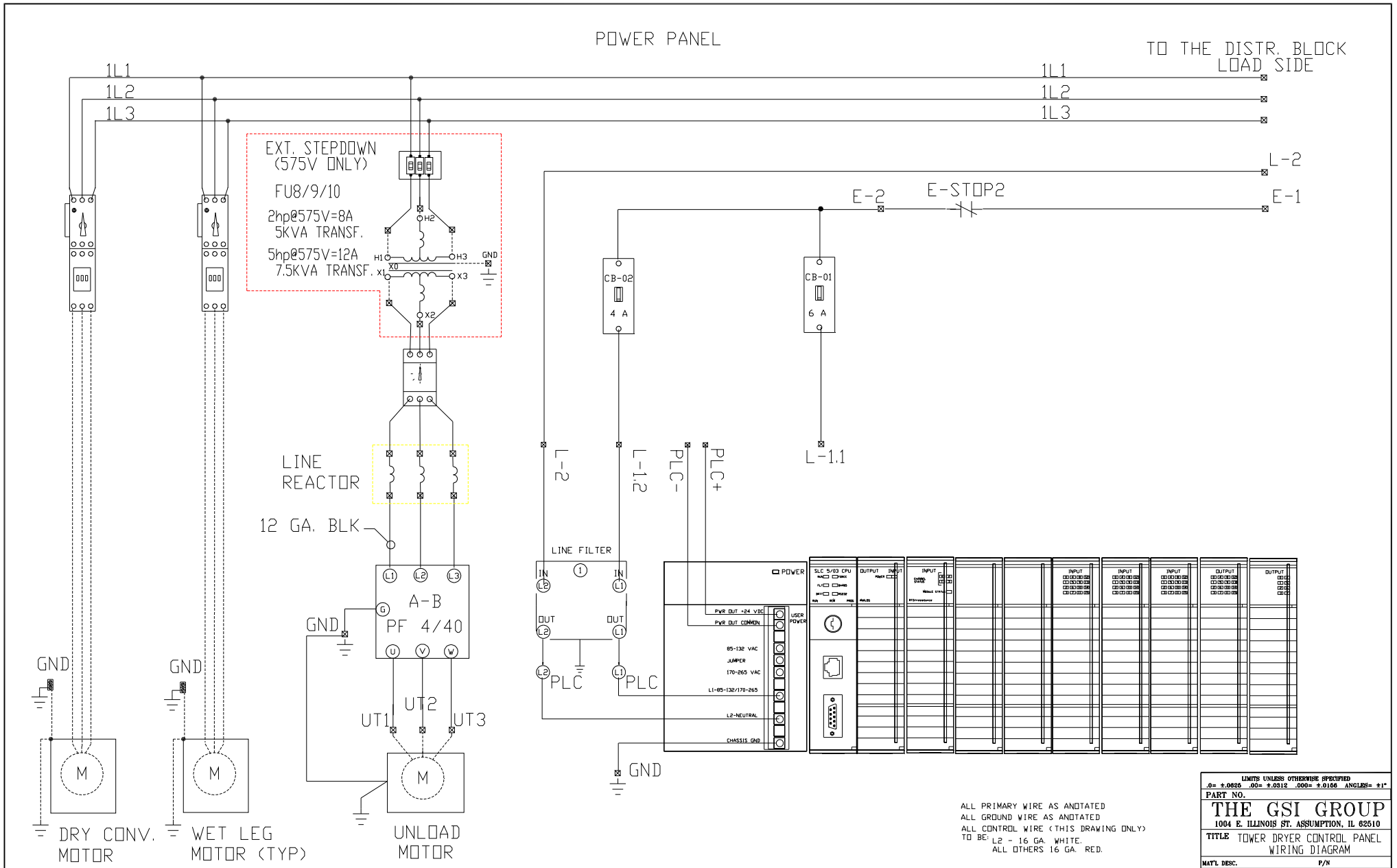
FOR 230V
L-2
L-2
GND
XXX
XXX
BLW-04
BLW-03
BLW-02
BLW-01
GND
M
WET CONV."A" MTR.
WET CONV."B" MTR.
BLOWER MTR.-04
BLOWER MTR.-03
BLOWER MTR.-02
BLOWER MTR.-01
LIMITS UNLESS OTHERWISE SPECIFIED
.0= ±.0625 .00= ±.0312 .000= ±.0156 ANGLES= ±1°
PART NO.
THE GSI GROUP
1004 E. ILLINOIS ST. ASSUMPTION, IL 62510
TITLE TOWER DRYER CONTROL PANEL WIRING DIAGRAM
MAT'L DESC.
P/N
DWG BY GL
DATE 04-10-04
DWG NO. 2004XX-01ACL
SCALE
SHEET 01A OF 18

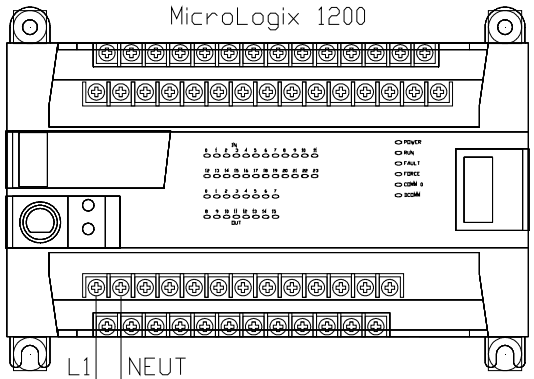

NO REVISIONS CHG BY DATE
POWER PANEL
PART WINDING
MAIN CB
ON
OFF
DOOR INTERLOCK
SHUT SAFETY CIRCUIT
1L1
1L2
1L3
CPT(VA@V) FU1/2/3
1000@230V 6/8/8A
1000@460V 6/3/3A
1000@575V 6/3/3A
1500@230V 6/12/12A
1500@380V 6/8/8
1500@460V 6/6/6A
1500@575V 6/6/6A
2000@230V 6/15/15A
2000@460V 6/8/8A
FU2/3
FU1
X-1
X-1
L-2
L-2
GND
XXXV
XXXX
120
CPT
H1-H3, H2-H4
FOR 230V
6M
5M
4M
3M
2M
1M
GND
GND
GND
GND
GND
GND
M
M
M
M
WET CONV."A" MTR.
BLOWER MTR.-03
BLOWER MTR.-02
BLOWER MTR.-01
L-2
503
CR-BLW3 3Sec TIMER
502
CR-BLW2 3Sec TIMER
501
CR-BLW1 3Sec TIMER
LIMITS UNLESS OTHERWISE SPECIFIED
.0= ±.0625 .00= ±.0312 .000= ±.0156 ANGLES= ±1°
PART NO.
THE GSI GROUP
1004 E. ILLINOIS ST. ASSUMPTION, IL 62510
TITLE TOWER DRYER CONTROL PANEL WIRING DIAGRAM
MAT'L DESC.
P/N
DWG BY QL
DATE 04-10-04
DWG NO. 2004XX-01PW
SCALE
SHEET 01PW OF 18


POWER PANEL
TRI-START
MAIN CB
ON
OFF
DOOR
INTERLOCK
SHUT
SAFETY
CIRCUIT
1L1
1L2
1L3
CPT(VA@V) FU1/2/3
1000@230V 6/8/8A
1000@460V 6/3/3A
1000@575V 6/3/3A
1500@230V 6/12/12A
1500@380V 6/8/8
1500@460V 6/6/6A
1500@575V 6/6/6A
2000@230V 6/15/15A
2000@460V 6/8/8A
FU2/3
X-1
X-1
FU1
CPT
XXXX
120
XXX
L-2
L-2 H1-H3, H2-H4
FOR 230V
GND
XXX
XXX
GND
GND
M
M
WET CONV."A" MTR.
WET CONV."B" MTR.
4LS
BLW-01
BLW-02
BLW-03
5MT1
4MT1
3MT1
3MT2
4MT2
5MT2
3LC
3MT3
5MT3
4MT3
BLOWER
BLOWER
M
M
M
BLOWER MTR.-01
BLOWER MTR.-02
BLOWER MTR.-03
NO REVISIONS CHG BY DATE
LIMITS UNLESS OTHERWISE SPECIFIED
.0= ±.0625 .00= ±.0312 .000= ±.0156 ANGLES= ±1°
PART NO.
THE GSI GROUP
1004 E. ILLINOIS ST. ASSUMPTION, IL 62510
TITLE TOWER DRYER CONTROL PANEL WIRING DIAGRAM
MAT'L DESC.
P/N
DWG BY QL
DATE 04-10-04
DWG NO. 2004XX-01TRI
SCALE
SHEET 01T OF 18


POWER PANEL
TO THE DISTR. BLOCK
LOAD SIDE
1L1
1L2
1L3
1L1
1L2
1L3
EXT. STEPDOWN
(575V ONLY)
FU8/9/10
2hp@575V=8A
5KVA TRANSF.
5hp@575V=12A
7.5KVA TRANSF.
H1
H2
H3
GND
X0
X1
X2
X3
L-2
E-2
E-STOP2
E-1
CB-02
4 A
CB-01
6 A
L-1.1
L-2
L-1.2
PLC-
PLC+
LINE
REACTOR
12 GA. BLK
LINE FILTER
IN
OUT
L1
L2
PLC
A-B
PF 4/40
G
U
V
W
GND
UT1
UT2
UT3
M
DRY CONV.
MOTOR
WET LEG
MOTOR (TYP)
UNLOAD
MOTOR
POWER
PWR OUT +24 VDC
PWR OUT COMMON
85-132 VAC
JUMPER
170-265 VAC
L1-85-132/170-265
L2-NEUTRAL
CHASSIS GND
USER
POWER
SLC 5/03 CPU
OUTPUT
INPUT
ALL PRIMARY WIRE AS ANOTATED
ALL GROUND WIRE AS ANOTATED
ALL CONTROL WIRE (THIS DRAWING ONLY)
TO BE: L2 - 16 GA. WHITE.
ALL OTHERS 16 GA. RED.
LIMITS UNLESS OTHERWISE SPECIFIED
.0= ±.0625 .00= ±.0312 .000= ±.0156 ANGLES= ±1°
PART NO.
THE GSI GROUP
1004 E. ILLINOIS ST. ASSUMPTION, IL 62510
TITLE TOWER DRYER CONTROL PANEL
WIRING DIAGRAM
MAT'L DESC.
P/N
DWG BY
QL
DATE
04-10-04
DWG NO.
2004XX-02
SCALE
SHEET
02 OF 18

CONTROL PANEL POWER SUPPLY

NO	REVISIONS	CHG BY	DATE



E-STOP1

E-1

CONTROL POWER SW

ON

OFF

C-1

X-1

XO

FROM THE CPT SECONDARY

L-2

CB-04

4 A

CB-03

4 A

GND

L-1.4

L-1.3

FAN HEATER

L1

L2

MODEM PWS
9.5VAC OUTPUT
PLUG INTO THE OUTLET

OIU

PANELVIEW PLUS 1000

POWER SUPPLY
24VDC

24VDC PWS
CONTROL PANEL

+V

-V

DCC+

DCC-

GND

DCC+

DCC-

TO MODEM

LIMITS UNLESS OTHERWISE SPECIFIED
.0= ±.0625 .00= ±.0312 .000= ±.0156 ANGLES= ±1°

PART NO.

THE GSI GROUP
1004 E. ILLINOIS ST. ASSUMPTION, IL 62510

TITLE TOWER DRYER CONTROL PANEL WIRING DIAGRAM

MAT'L DESC.		P/N
DWG BY QL	DATE 04-10-04	DWG NO. 2004XX-03
SCALE	SHEET 03 OF 18	

	PART NO.	DESCRIPTION		ASSY
	XXX-XXXX-X	NETWORKS FOR 2004 CONTROL		X
	JOB#	THIS PANEL		X
ITEM	PART NO.	CAT. NO.	DESCRIPTION	QTY
0	XXX-XXXX-X	1747-AIC	ISOLATED LINK COUPLER	1 1
1	756-2159-9	1746-A10	RACK 10 SLOT	1 1
2	756-1795-1	1746-P4	PWR SUPPLY	1 1
3	756-1796-9	1747-L532	CPU W/ OS302 V.7 OR LATER	1 1
4	756-1797-7	1747-M11	EEPROM	1 1
5	756-1799-3	1746-NID41	A'LOG 2x2	1 1
6	756-2161-5	1746-NR4	PLC AB RTD MODULE	1 1
7	756-1807-4	1746-N2	SLOT COVER	1 1
8	756-1807-4	1746-N2	SLOT COVER	1 1
9	GT3-0810	1746-IB16	PLC AB DIX16VDC	3 3
10	756-1801-7	1746-OW16	PLC AB DOX16 120VAC	1 1
11	GT3-XXX-X	1746-OX8	PLC AB DOX8 ISOLATED 120VAC	1 1
12	GT3-XXX-X	1761-NET-AIC	ADVANCED INTERFACE CONVERTER	1 1
13	XXX-XXXX-X	1762-L40BWA	PLC AB MICRO 1200 24DIX16DO	1 1
14	XXX-XXXX-X	2711P-RDB10C	PV+ 1000 DISPLAY W/ KEY&TOUCH	1 1
15	XXX-XXXX-X	2711P-RP	PV+ LOGIC MODULE	1 1
16	XXX-XXXX-X	2711P-RGK10	PV+ 1000 ANTIGLARE OVERLAY	1 1
17				
18				
19				
20	XXX-XXXX-X	1761-CBL-AM00	CABLE ASSM. AIC+ TO MICRO 18"	1 1
21	XXX-XXXX-X	BELDEN #9842	DH485 NETWORK CABLE	1 1
22				
23				
24	056-2327-7	1747-C10	CABLE ASSM. AIC TO SLC(6')	1 1
25	XXX-XXXX-X		MODEM CABLE	1 1
26	D03-0358	US ROBOTICS	MODEM 33.6K DATA/FAX	1 1

NETWORKS

NOTE: DC SOURCE SW = CABLE

DIU

PANELVIEW PLUS 1000

POWER SUPPLY 24VDC

GND

CONTROL PANEL

POWER PANEL

NOTE: CONNECT TO CHASIS GND AT THIS NODE ONLY

DH-485 INTFC

JUMPER
ORG/WHT
WHT/ORG
BLU/WHT
SHLD
JUMPER

TERM
A
B
COM
SHLD
GND

GND

GND

POWER

PWR OUT +24 VDC
PWR OUT COMMON
85-132 VAC
JUMPER
170-265 VAC
L1-85-132/170-265
L2-NEUTRAL
CHASSIS GND

USER POWER

SLC 5/03 CPU

OUTPUT

INPUT

MODEM

MODEM CABLE WIRING DIAGRAM:

DB9F		DB25F
1	----------	8
2	----------	3
3	----------	2
4	----------	20
5	----------	7
6	----------	6
7	----------	4
8	----------	5
9	----------	22

LIMITS UNLESS OTHERWISE SPECIFIED
.0= ±.0625 .00= ±.0312 .000= ±.0156 ANGLES= ±1°

PART NO.

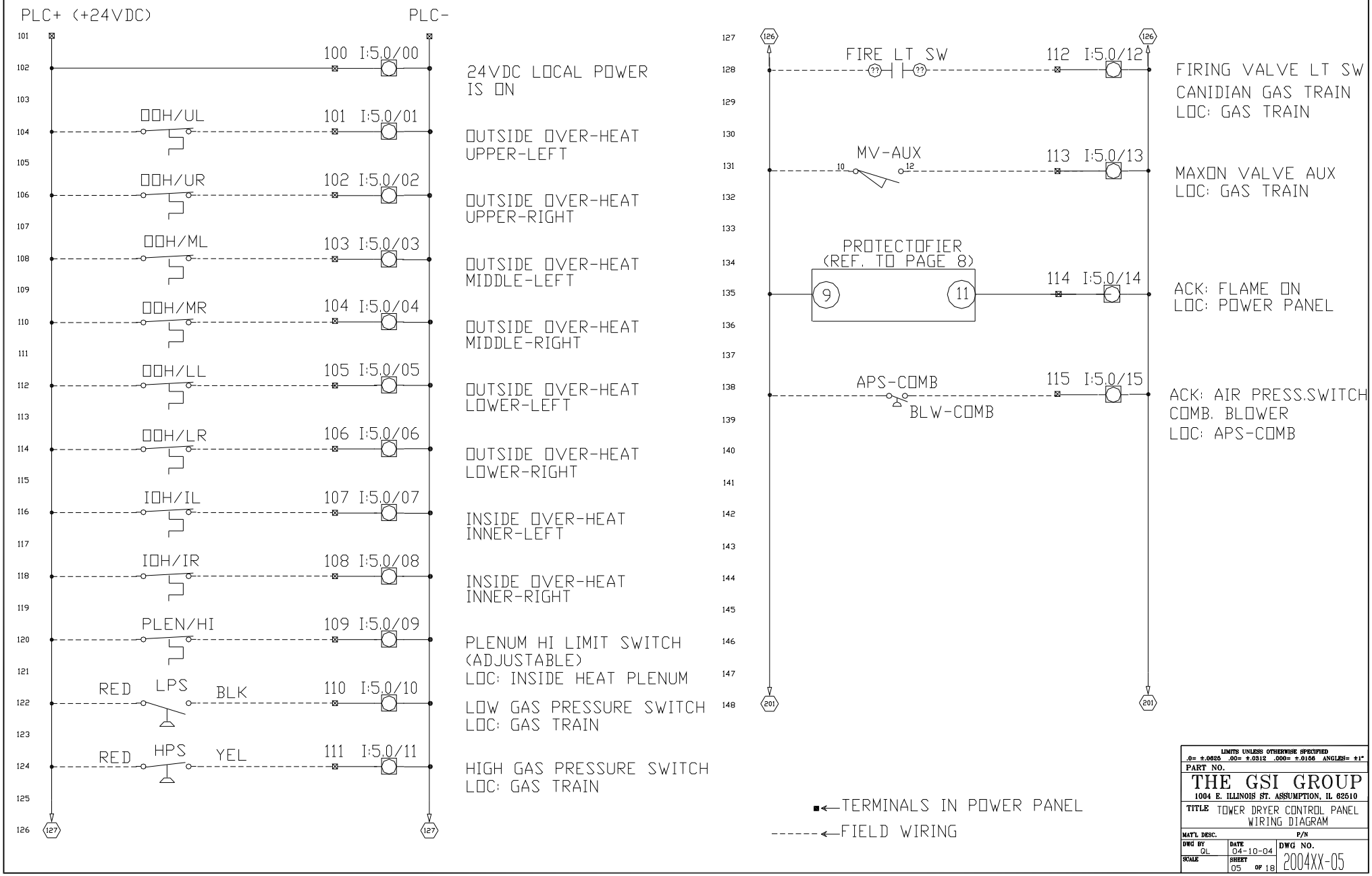
THE GSI GROUP
1004 E. ILLINOIS ST. ASSUMPTION, IL 62510

TITLE TOWER DRYER CONTROL PANEL WIRING DIAGRAM

MAT'L DESC. P/N

DWG BY GL | DATE 04-10-04 | DWG NO. 2004XX-04

SCALE | SHEET 04 OF 18



LIMITS UNLESS OTHERWISE SPECIFIED
.0= ±.0625 .00= ±.0312 .000= ±.0156 ANGLES= ±1°

PART NO.

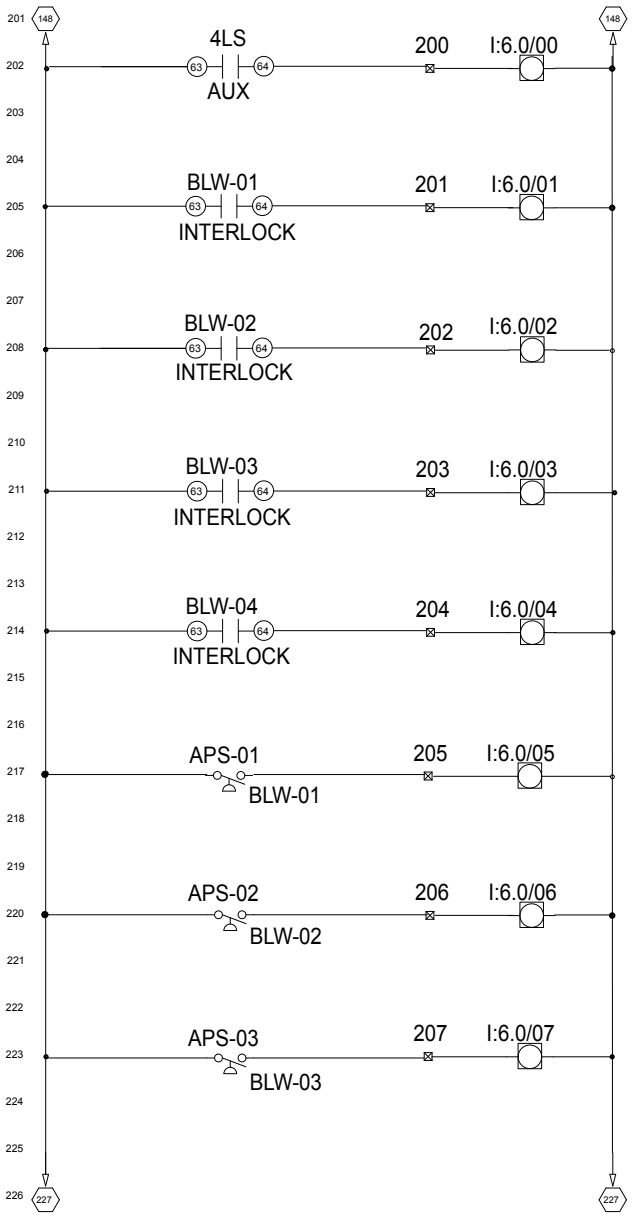
THE GSI GROUP

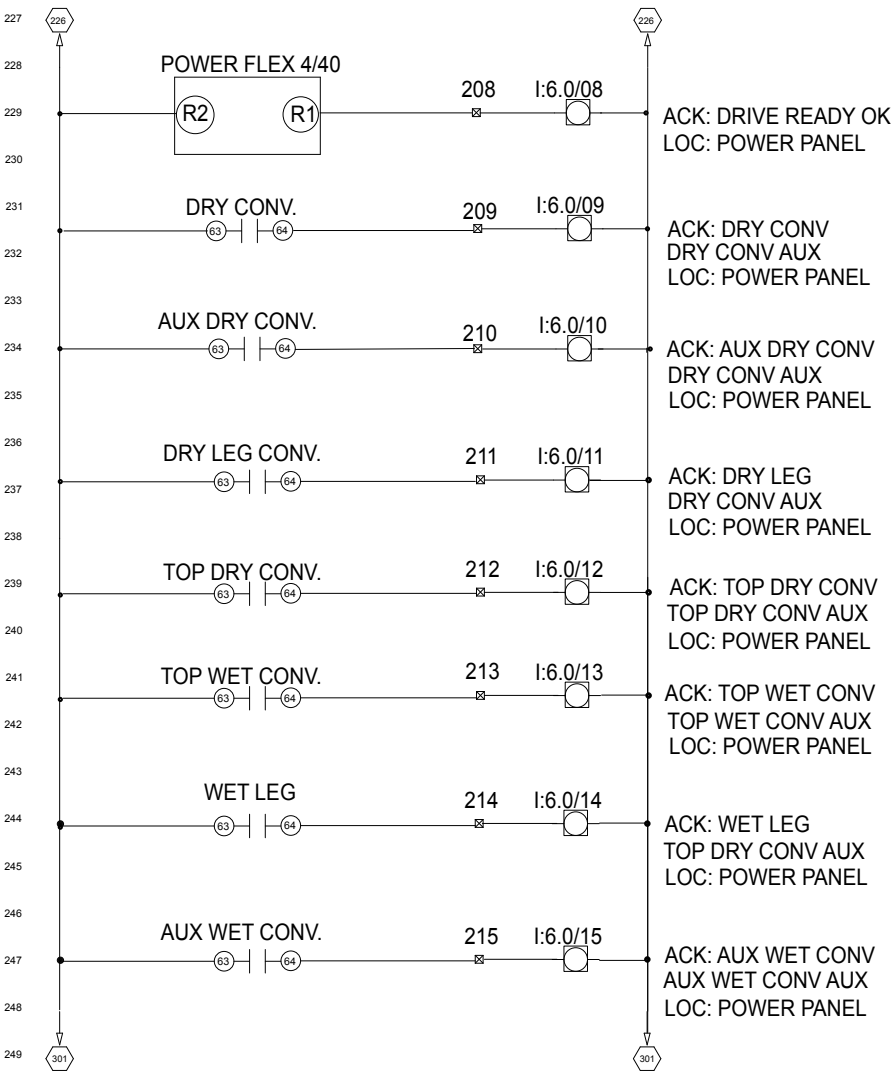
1004 E. ILLINOIS ST. ASSUMPTION, IL 62510

TITLE TOWER DRYER CONTROL PANEL WIRING DIAGRAM

MAT'L DESC. P/N

DWG BY	DATE	DWG NO.
QL	04-10-04	2004XX-05
SCALE	SHEET 05 OF 18	





■← TERMINALS IN POWER PANEL

——← FIELD WIRING

LIMITS UNLESS OTHERWISE SPECIFIED
.0= ±.0625 .00= ±.0312 .000= ±.0156 ANGLES= ±1°

PART NO.

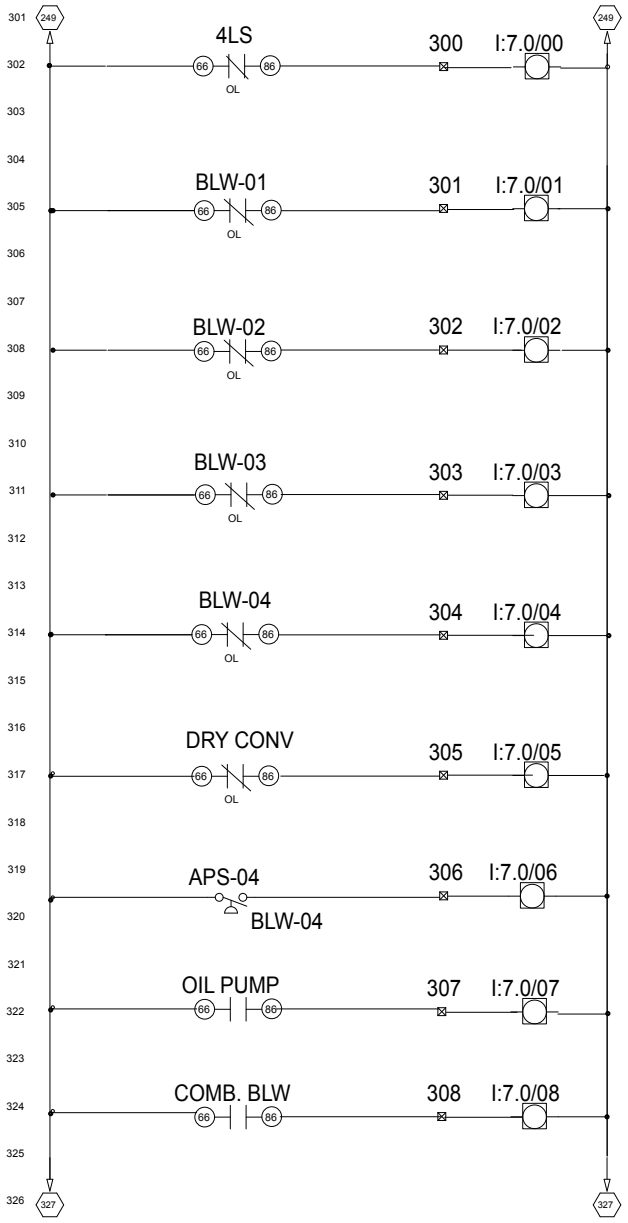
THE GSI GROUP
1004 E. ILLINOIS ST. ASSUMPTION, IL 62510

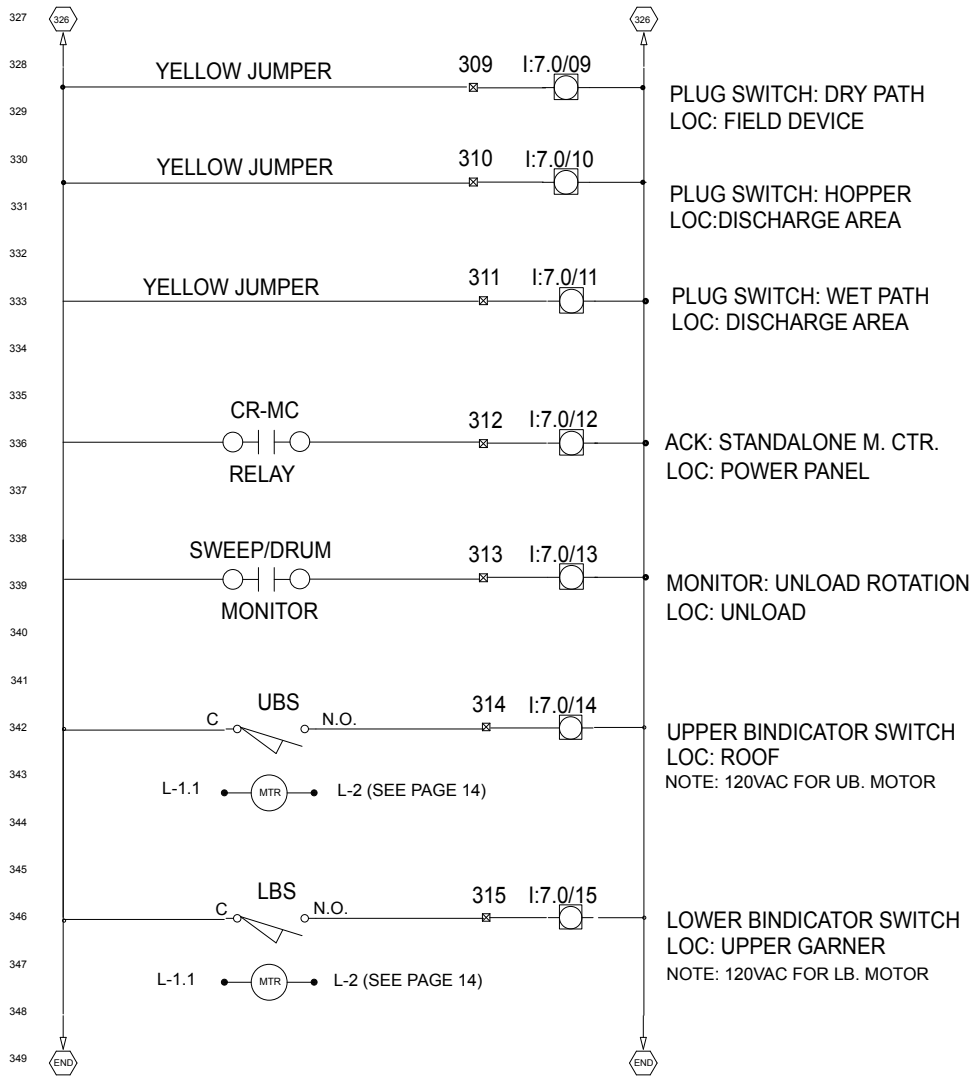
TITLE: TOWER DRYER CONTROL PANEL WIRING DIAGRAM

MAT'L DESC. | P/N

DWG BY: QL | DATE: 04-10-04 | DWG NO.: 2004XX-06

SCALE | SHEET: 06 OF 18





■← TERMINALS IN POWER PANEL

——— ← FIELD WIRING

LIMITS UNLESS OTHERWISE SPECIFIED
.0= ±.0625 .00= ±.0312 .000= ±.0156 ANGLES= ±1°

PART NO.

THE GSI GROUP

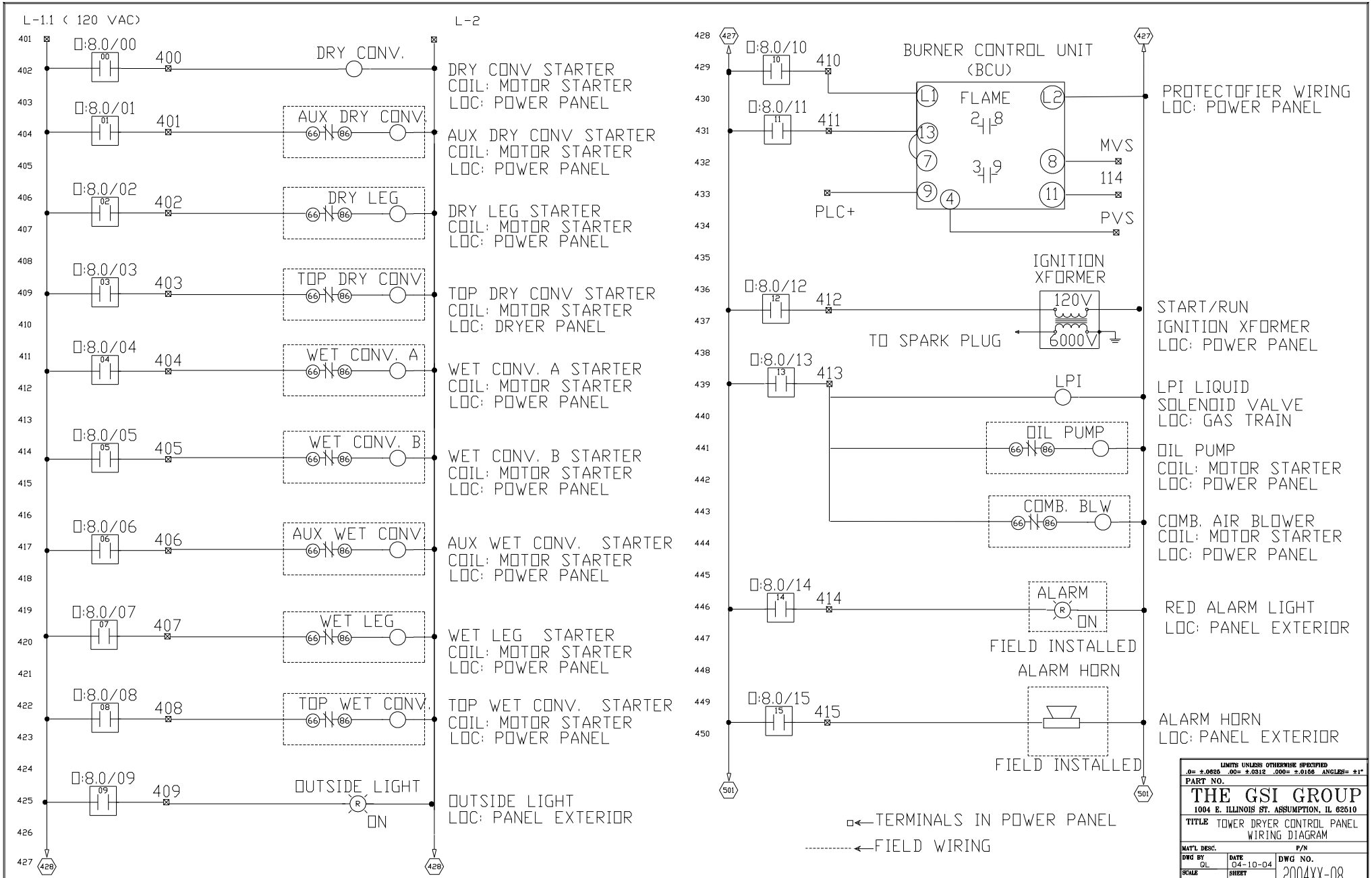
1004 E. ILLINOIS ST. ASSUMPTION, IL 62510

TITLE: TOWER DRYER CONTROL PANEL WIRING DIAGRAM

MAT'L DESC. | P/N

DWG BY: QL | DATE: 04-10-04 | DWG NO.: 2004XX-07

SCALE | SHEET: 07 OF 18



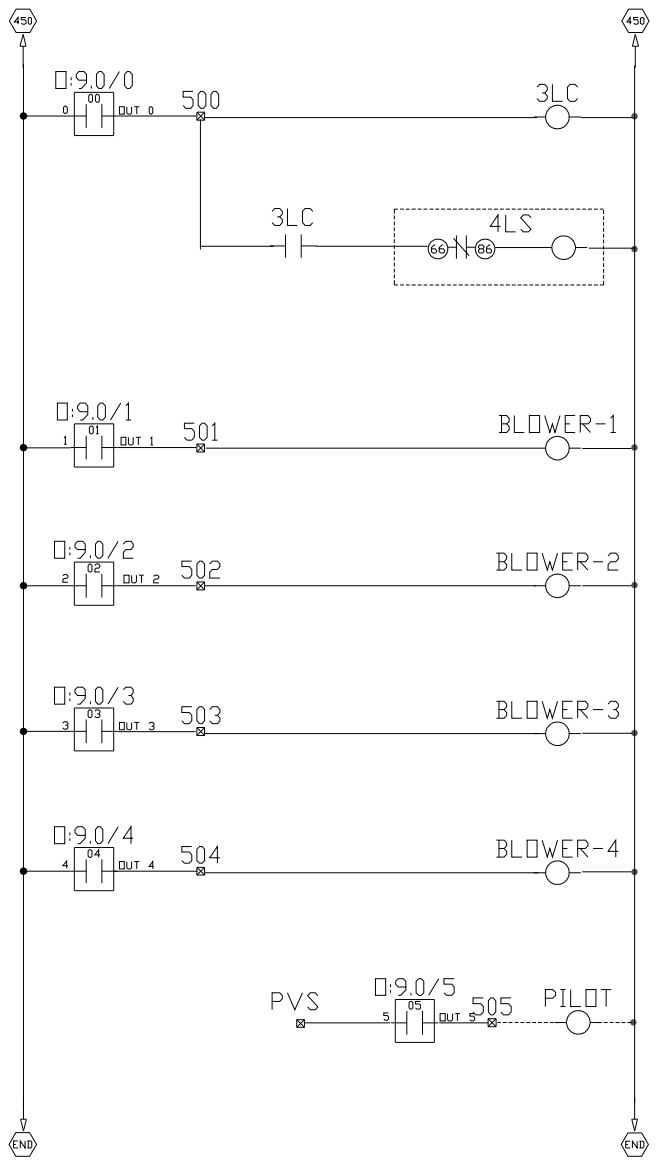
LIMITS UNLESS OTHERWISE SPECIFIED
.0= ±.0625 .00= ±.0312 .000= ±.0156 ANGLES= ±1°

PART NO.

THE GSI GROUP
1004 E. ILLINOIS ST. ASSUMPTION, IL 62510

TITLE TOWER DRYER CONTROL PANEL WIRING DIAGRAM

MAT'L DESC.		P/N
DWG BY QL	DATE 04-10-04	DWG NO. 2004XX-08
SCALE	SHEET 08 OF 18	



LOW CURRENT BLOWER CONTACTOR
COIL: CONTACTOR 3LC
LOC: POWER PANEL

LOW CURRENT BLOWER CONTACTOR
COIL: CONTACTOR 3LC
LOC: POWER PANEL

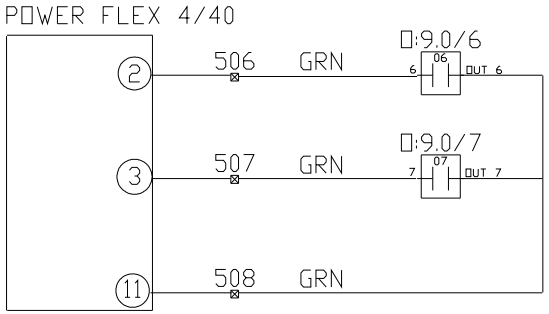
BLOWER 01 STARTER
COIL: MOTOR CONTACTOR
LOC: POWER PANEL

BLOWER 02 STARTER
COIL: MOTOR CONTACTOR
LOC: POWER PANEL

BLOWER 03 STARTER
COIL: MOTOR CONTACTOR
LOC: POWER PANEL

BLOWER 04 STARTER
COIL: MOTOR CONTACTOR
LOC: POWER PANEL

ENABLE PILOT SOLENOID
PILOT SOLENOID COIL
LOC: POWER PANEL



■←TERMINALS IN POWER PANEL

----------←FIELD WIRING

LIMITS UNLESS OTHERWISE SPECIFIED
.0= ±.0625 .00= ±.0312 .000= ±.0156 ANGLES= ±1°

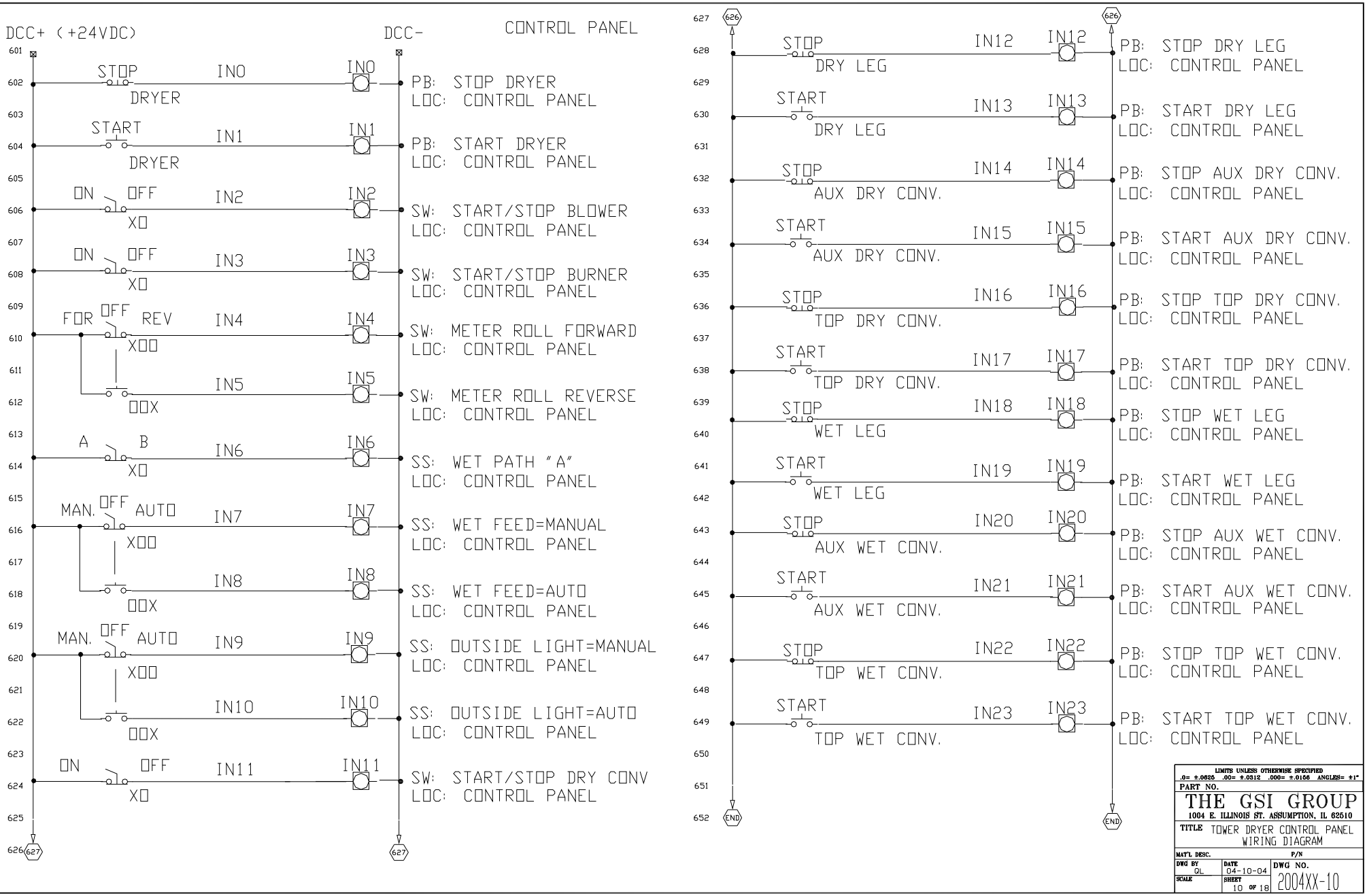
PART NO.

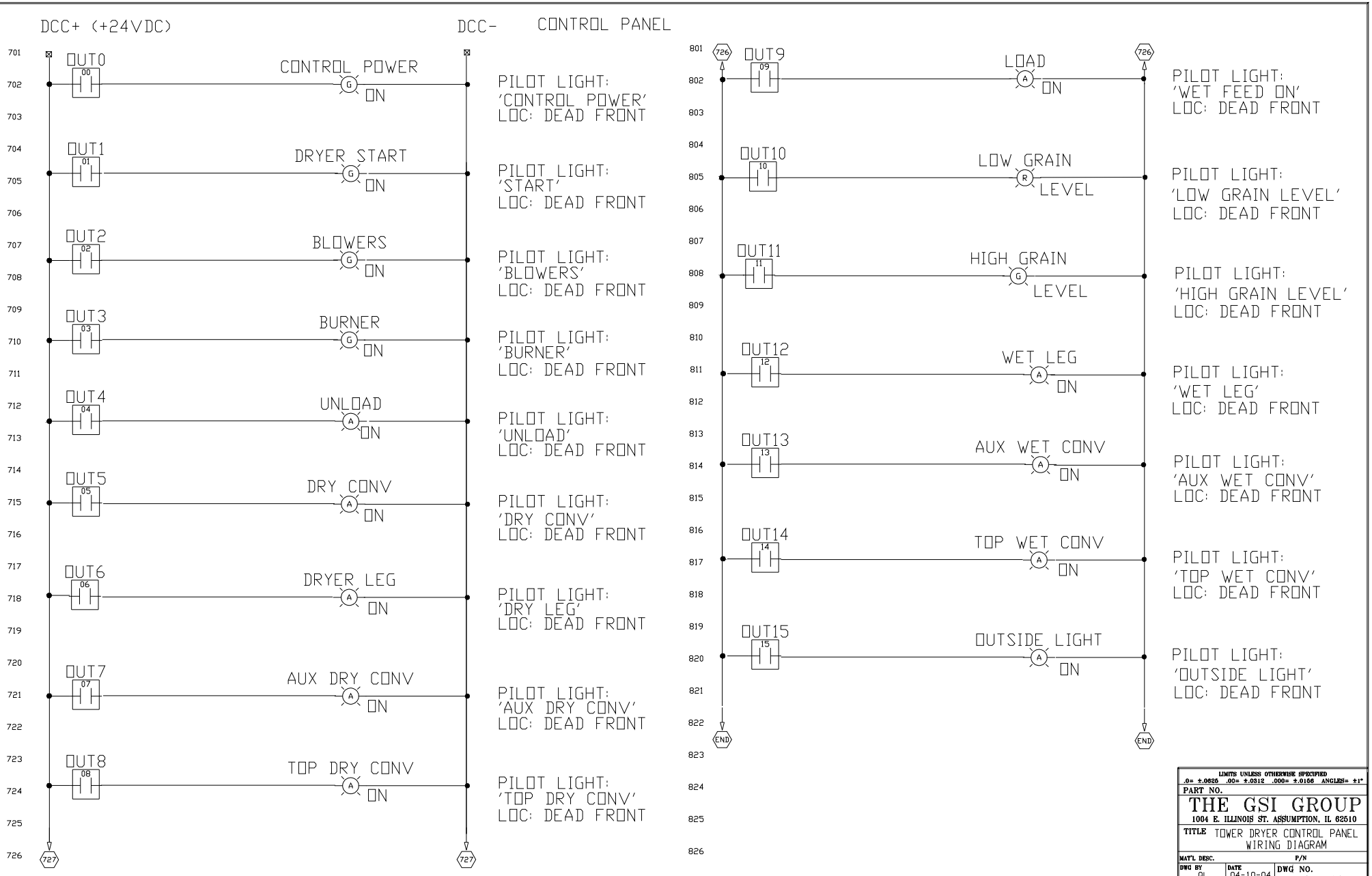
THE GSI GROUP
1004 E. ILLINOIS ST. ASSUMPTION, IL 62510

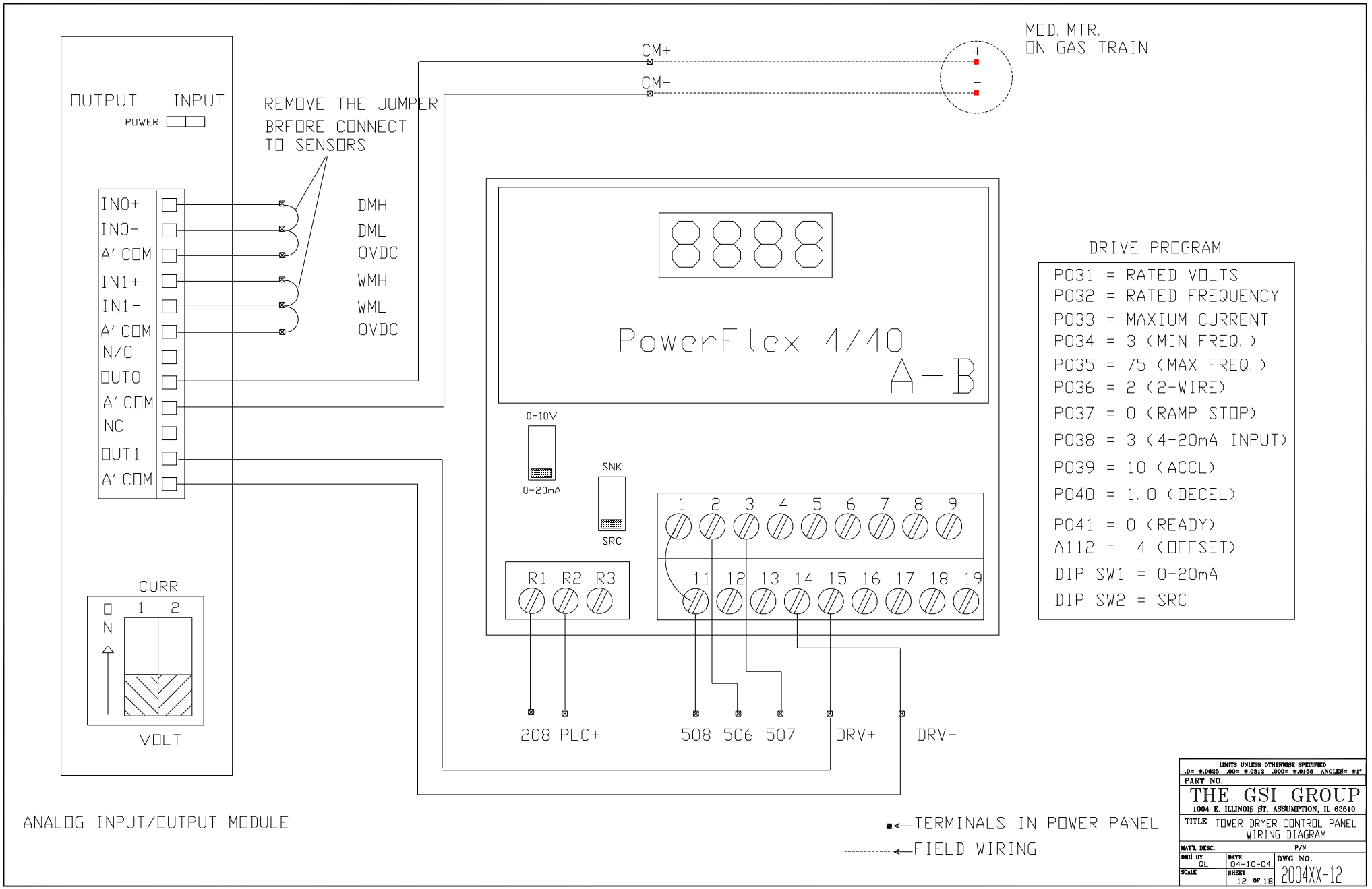
TITLE TOWER DRYER CONTROL PANEL WIRING DIAGRAM

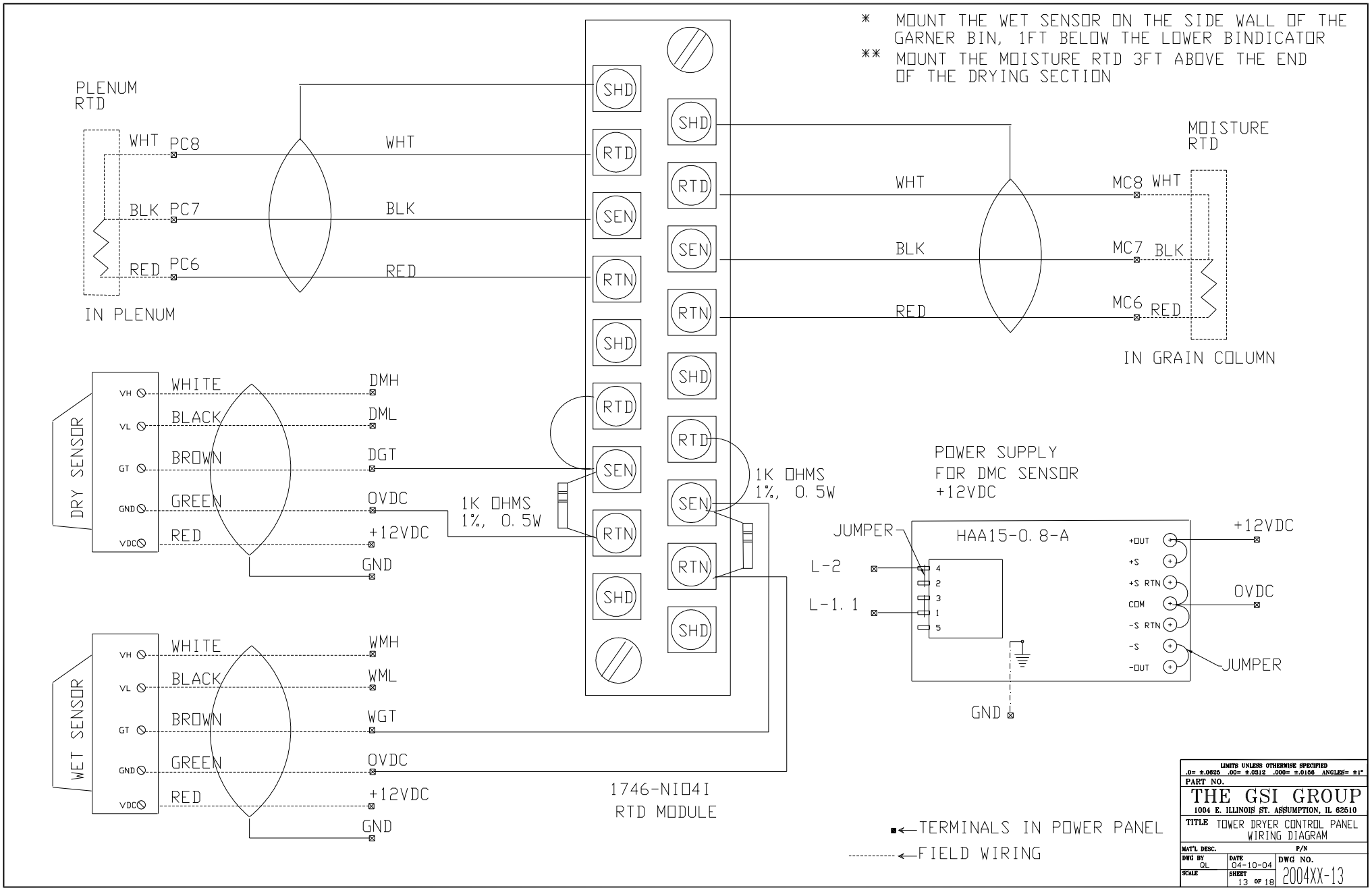
MAT'L DESC. P/N

DWG BY	DATE	DWG NO.
QL	04-10-04	2004XX-09
SCALE	SHEET 09 OF 18	


DCC+ (+24VDC)
DCC-
CONTROL PANEL
STOP
DRYER
IN0
PB: STOP DRYER
LOC: CONTROL PANEL
START
DRYER
IN1
PB: START DRYER
LOC: CONTROL PANEL
ON
OFF
X0
IN2
SW: START/STOP BLOWER
LOC: CONTROL PANEL
ON
OFF
X0
IN3
SW: START/STOP BURNER
LOC: CONTROL PANEL
FOR
OFF
REV
X00
IN4
SW: METER ROLL FORWARD
LOC: CONTROL PANEL
00X
IN5
SW: METER ROLL REVERSE
LOC: CONTROL PANEL
A
B
X0
IN6
SS: WET PATH "A"
LOC: CONTROL PANEL
MAN.
OFF
AUTO
X00
IN7
SS: WET FEED=MANUAL
LOC: CONTROL PANEL
00X
IN8
SS: WET FEED=AUTO
LOC: CONTROL PANEL
MAN.
OFF
AUTO
X00
IN9
SS: OUTSIDE LIGHT=MANUAL
LOC: CONTROL PANEL
00X
IN10
SS: OUTSIDE LIGHT=AUTO
LOC: CONTROL PANEL
ON
OFF
X0
IN11
SW: START/STOP DRY CONV
LOC: CONTROL PANEL
STOP
DRY LEG
IN12
PB: STOP DRY LEG
LOC: CONTROL PANEL
START
DRY LEG
IN13
PB: START DRY LEG
LOC: CONTROL PANEL
STOP
AUX DRY CONV.
IN14
PB: STOP AUX DRY CONV.
LOC: CONTROL PANEL
START
AUX DRY CONV.
IN15
PB: START AUX DRY CONV.
LOC: CONTROL PANEL
STOP
TOP DRY CONV.
IN16
PB: STOP TOP DRY CONV.
LOC: CONTROL PANEL
START
TOP DRY CONV.
IN17
PB: START TOP DRY CONV.
LOC: CONTROL PANEL
STOP
WET LEG
IN18
PB: STOP WET LEG
LOC: CONTROL PANEL
START
WET LEG
IN19
PB: START WET LEG
LOC: CONTROL PANEL
STOP
AUX WET CONV.
IN20
PB: STOP AUX WET CONV.
LOC: CONTROL PANEL
START
AUX WET CONV.
IN21
PB: START AUX WET CONV.
LOC: CONTROL PANEL
STOP
TOP WET CONV.
IN22
PB: STOP TOP WET CONV.
LOC: CONTROL PANEL
START
TOP WET CONV.
IN23
PB: START TOP WET CONV.
LOC: CONTROL PANEL
626
627
END
LIMITS UNLESS OTHERWISE SPECIFIED
.0= ±.0625 .00= ±.0312 .000= ±.0156 ANGLES= ±1°
PART NO.
THE GSI GROUP
1004 E. ILLINOIS ST. ASSUMPTION, IL 62510
TITLE TOWER DRYER CONTROL PANEL WIRING DIAGRAM
MAT'L DESC.
P/N
DWG BY QL
DATE 04-10-04
DWG NO. 2004XX-10
SCALE
SHEET 10 OF 18


DCC+ (+24VDC)
DCC-
CONTROL PANEL
OUT0
00
CONTROL POWER
G
ON
PILOT LIGHT:
'CONTROL POWER'
LOC: DEAD FRONT
OUT1
01
DRYER START
G
ON
PILOT LIGHT:
'START'
LOC: DEAD FRONT
OUT2
02
BLOWERS
G
ON
PILOT LIGHT:
'BLOWERS'
LOC: DEAD FRONT
OUT3
03
BURNER
G
ON
PILOT LIGHT:
'BURNER'
LOC: DEAD FRONT
OUT4
04
UNLOAD
A
ON
PILOT LIGHT:
'UNLOAD'
LOC: DEAD FRONT
OUT5
05
DRY CONV
A
ON
PILOT LIGHT:
'DRY CONV'
LOC: DEAD FRONT
OUT6
06
DRYER LEG
A
ON
PILOT LIGHT:
'DRY LEG'
LOC: DEAD FRONT
OUT7
07
AUX DRY CONV
A
ON
PILOT LIGHT:
'AUX DRY CONV'
LOC: DEAD FRONT
OUT8
08
TOP DRY CONV
A
ON
PILOT LIGHT:
'TOP DRY CONV'
LOC: DEAD FRONT
727
OUT9
09
LOAD
A
ON
PILOT LIGHT:
'WET FEED ON'
LOC: DEAD FRONT
OUT10
10
LOW GRAIN
R
LEVEL
PILOT LIGHT:
'LOW GRAIN LEVEL'
LOC: DEAD FRONT
OUT11
11
HIGH GRAIN
G
LEVEL
PILOT LIGHT:
'HIGH GRAIN LEVEL'
LOC: DEAD FRONT
OUT12
12
WET LEG
A
ON
PILOT LIGHT:
'WET LEG'
LOC: DEAD FRONT
OUT13
13
AUX WET CONV
A
ON
PILOT LIGHT:
'AUX WET CONV'
LOC: DEAD FRONT
OUT14
14
TOP WET CONV
A
ON
PILOT LIGHT:
'TOP WET CONV'
LOC: DEAD FRONT
OUT15
15
OUTSIDE LIGHT
A
ON
PILOT LIGHT:
'OUTSIDE LIGHT'
LOC: DEAD FRONT
726
END
LIMITS UNLESS OTHERWISE SPECIFIED
.0= ±.0625 .00= ±.0312 .000= ±.0156 ANGLES= ±1°
PART NO.
THE GSI GROUP
1004 E. ILLINOIS ST. ASSUMPTION, IL 62510
TITLE TOWER DRYER CONTROL PANEL WIRING DIAGRAM
MAT'L DESC.
P/N
DWG BY QL
DATE 04-10-04
DWG NO. 2004XX-11
SCALE
SHEET 11 OF 18


OUTPUT INPUT
POWER
REMOVE THE JUMPER
BRFORE CONNECT
TO SENSORS
INO+
INO-
A' COM
IN1+
IN1-
A' COM
N/C
OUTO
A' COM
NC
OUT1
A' COM
DMH
DML
OVDC
WMH
WML
OVDC
CURR
ON
1 2
VOLT
CM+
CM-
+
-
MOD. MTR.
ON GAS TRAIN
8888
PowerFlex 4/40
A-B
0-10V
0-20mA
SNK
SRC
1 2 3 4 5 6 7 8 9
R1 R2 R3
11 12 13 14 15 16 17 18 19
208 PLC+
508 506 507
DRV+
DRV-
DRIVE PROGRAM
P031 = RATED VOLTS
P032 = RATED FREQUENCY
P033 = MAXIUM CURRENT
P034 = 3 (MIN FREQ.)
P035 = 75 (MAX FREQ.)
P036 = 2 (2-WIRE)
P037 = 0 (RAMP STOP)
P038 = 3 (4-20mA INPUT)
P039 = 10 (ACCL)
P040 = 1.0 (DECEL)
P041 = 0 (READY)
A112 = 4 (OFFSET)
DIP SW1 = 0-20mA
DIP SW2 = SRC
ANALOG INPUT/OUTPUT MODULE
TERMINALS IN POWER PANEL
FIELD WIRING
LIMITS UNLESS OTHERWISE SPECIFIED
.0= ±.0625 .00= ±.0312 .000= ±.0156 ANGLES= ±1°
PART NO.
THE GSI GROUP
1004 E. ILLINOIS ST. ASSUMPTION, IL 62510
TITLE TOWER DRYER CONTROL PANEL WIRING DIAGRAM
MAT'L DESC.
P/N
DWG BY QL
DATE 04-10-04
DWG NO. 2004XX-12
SCALE
SHEET 12 OF 18


* MOUNT THE WET SENSOR ON THE SIDE WALL OF THE GARNER BIN, 1FT BELOW THE LOWER BINDICATOR
** MOUNT THE MOISTURE RTD 3FT ABOVE THE END OF THE DRYING SECTION
PLENUM RTD
WHT PC8
BLK PC7
RED PC6
IN PLENUM
WHT
BLK
RED
SHD
RTD
SEN
RTN
MOISTURE RTD
MC8 WHT
MC7 BLK
MC6 RED
IN GRAIN COLUMN
DRY SENSOR
VH
VL
GT
GND
VDC
WHITE
BLACK
BROWN
GREEN
RED
DMH
DML
DGT
OVDC
+12VDC
GND
1K OHMS 1%, 0.5W
1K OHMS 1%, 0.5W
POWER SUPPLY FOR DMC SENSOR +12VDC
JUMPER
L-2
L-1.1
HAA15-0.8-A
+OUT
+S
+S RTN
COM
-S RTN
-S
-OUT
+12VDC
OVDC
JUMPER
GND
WET SENSOR
WMH
WML
WGT
1746-NI04I
RTD MODULE
TERMINALS IN POWER PANEL
FIELD WIRING
LIMITS UNLESS OTHERWISE SPECIFIED
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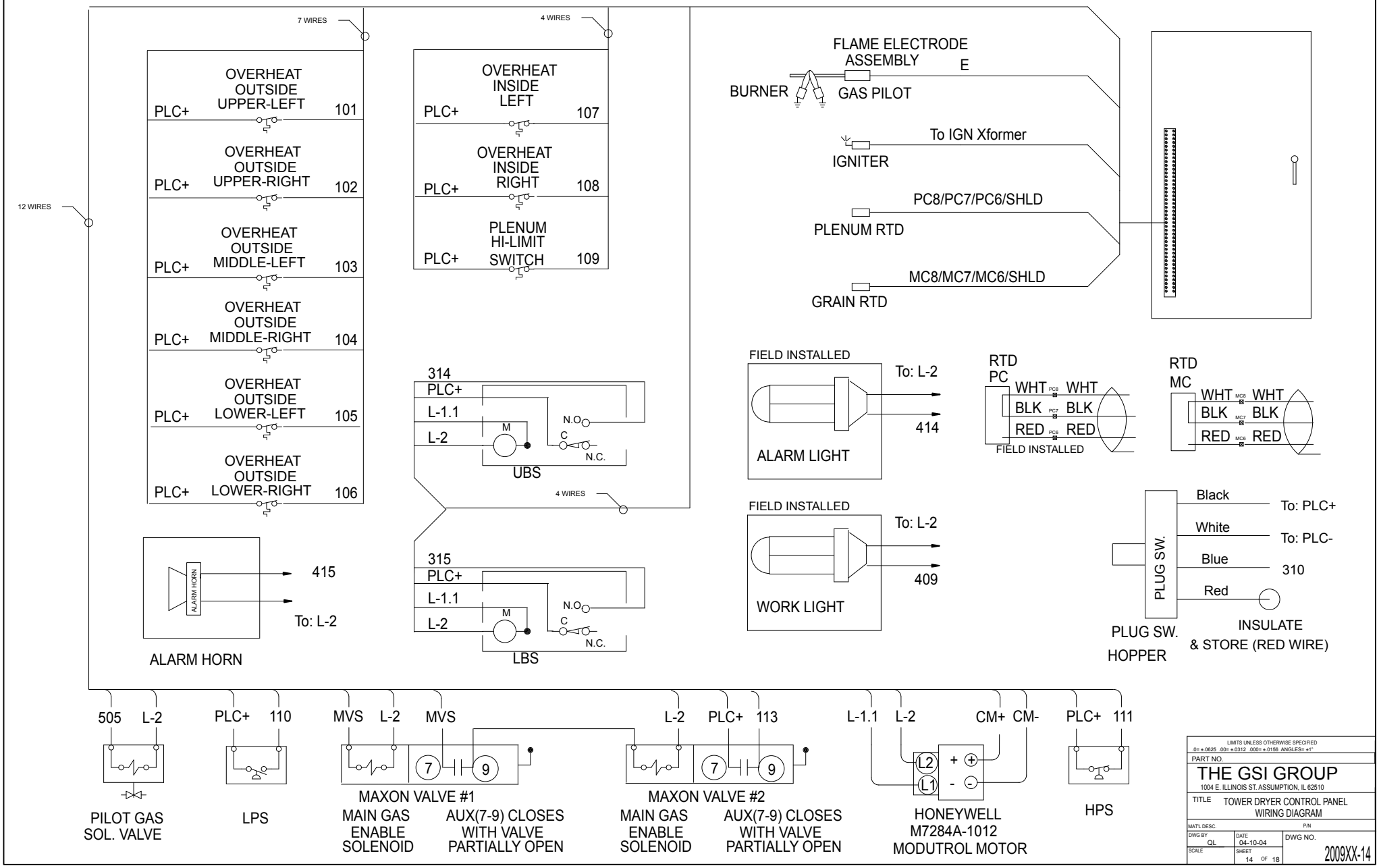
1004 E. ILLINOIS ST. ASSUMPTION, IL 62510
TITLE TOWER DRYER CONTROL PANEL WIRING DIAGRAM
MAT'L DESC.
P/N
DWG BY QL
DATE 04-10-04
DWG NO. 2004XX-13
SCALE
SHEET 13 OF 18

FIELD WIRING



LIMITS UNLESS SPECIFIED
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PART NO.

THE GSI GROUP
1004 E. ILLINOIS ST. ASSUMPTION, IL 62510

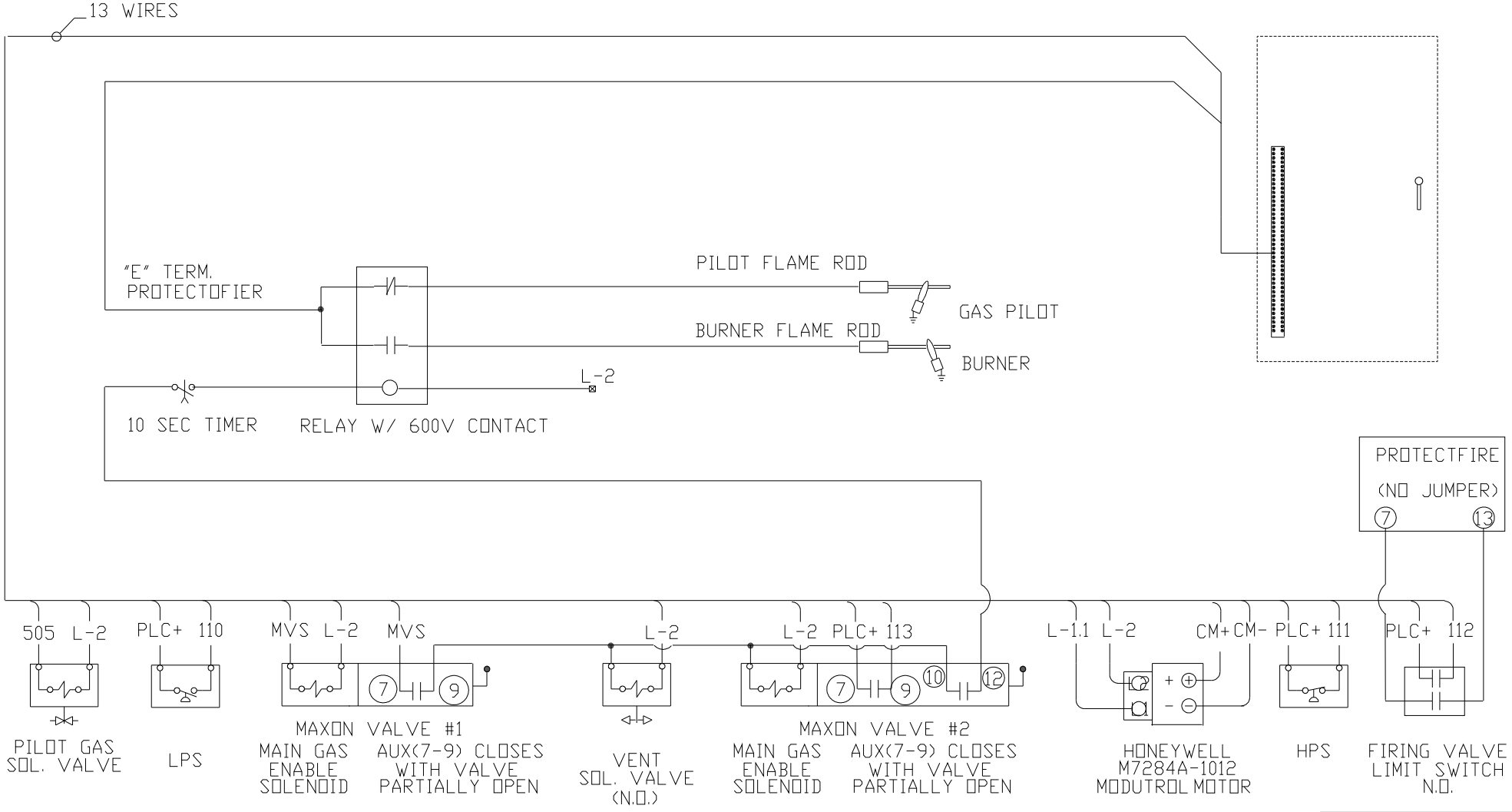
TITLE: TOWER DRYER CONTROL PANEL WIRING DIAGRAM

MAT'L DESC. | P/N

DWG BY: QL | DATE: 04-10-04 | DWG NO.: 2009XX-14

SCALE | SHEET: 14 OF 18

CANADIAN FUEL TRAIN WIRING



LIMITS UNLESS OTHERWISE SPECIFIED
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PART NO.

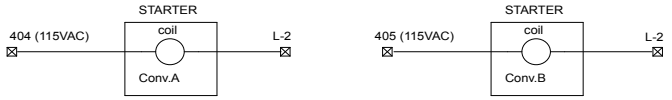
THE GSI GROUP
1004 E. ILLINOIS ST. ASSUMPTION, IL 62510

TITLE TOWER DRYER CONTROL PANEL WIRING DIAGRAM

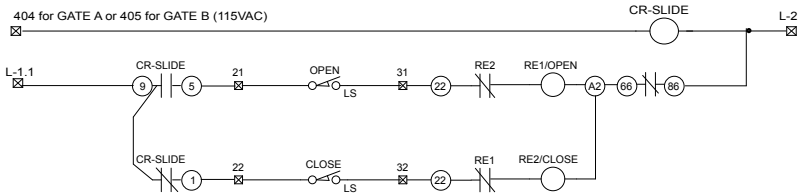
MAT'L DESC.		P/N
DWG BY QL	DATE 04-10-04	DWG NO. 2004XX-15
SCALE	SHEET 15 OF 18	

WET CONVEYOR's "A" & "B" - These wet grain transports can be either: conveyors, or slide gates.
Either "A" or "B" can be selected from the "WET PATH" selector switch.

Wet coveyor starter wiring is like this:



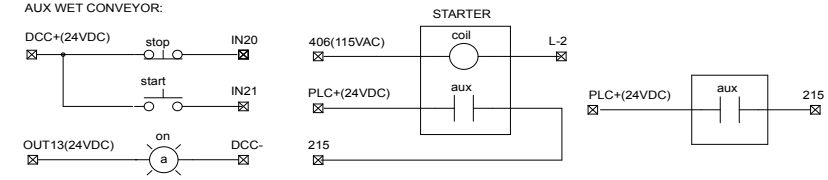
Wet slide gate wiring is like this:



AUX WET CONVEYOR, WET LEG AND TOP WET CONVEYOR:

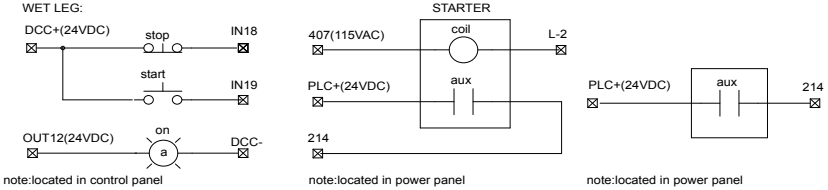
1) You may purchase the optional starters, push buttons, & pilot lights installed in the dryer panel, which are connected as shown by the draws in left and center columns.
2) If you have an existing starter system, connect the aux contact of your device as shown in the draws to the right column.
3) Do not forget to select the device option from the DRYER SETUP screen of the operator after the device is installed.

AUX WET CONVEYOR:



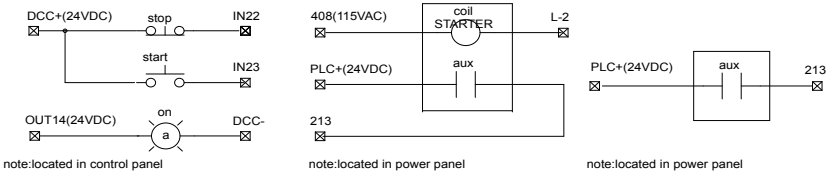
note:located in control panel | note:located in power panel | note:located in power panel

WET LEG:



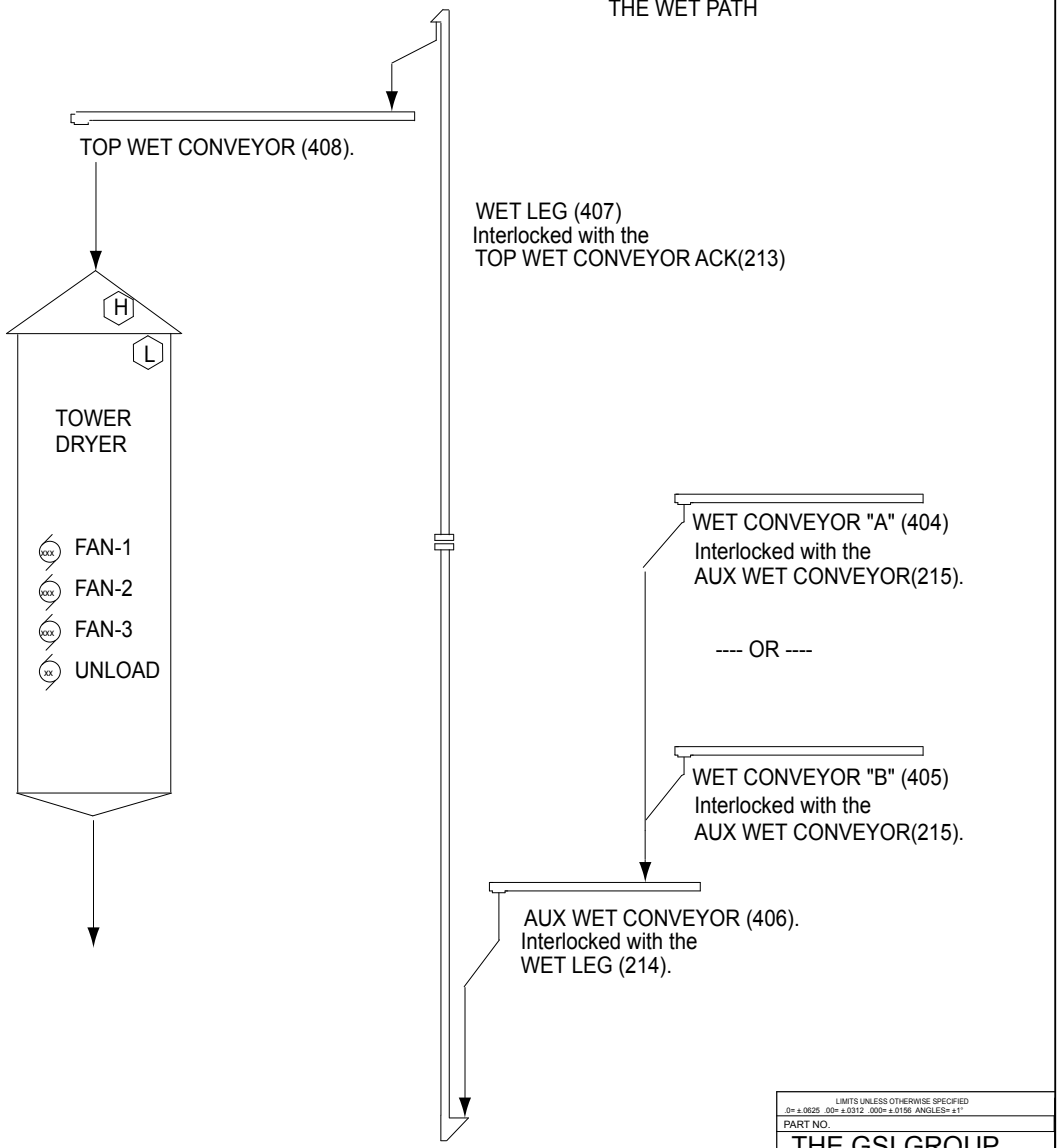
note:located in control panel | note:located in power panel | note:located in power panel

TOP WET CONVEYOR:



note:located in control panel | note:located in power panel | note:located in power panel

THE WET PATH



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PART NO.

THE GSI GROUP
1004 E. ILLINOIS ST. ASSUMPTION, IL 62510

TITLE: TOWER DRYER CONTROL PANEL WIRING DIAGRAM

MAT'L DESC. | P/N

DWG BY	DATE	DWG NO.
QL	04-10-04	2004XX-16
SCALE	SHEET 16 OF 18	

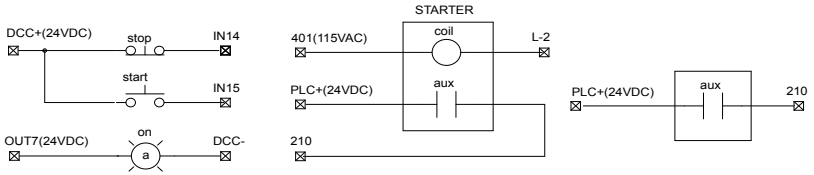
DRY CONVEYOR:
This is the dry grain transport located directly under the dryer discharge hopper.
All tower dryer control panels include a starter to control this function. Simply hook up the motor T leads to the starter & check rotation. The included dry Conveyor starter aux is the run-permissive for the dryer unload. Please use this starter!

If you wish to add plug switches to the Dry Conveyor, remove the yellow jumper wire between PLC+ and 309, and install a N.C. dry contacts, in series between PLC+ & 309.

Do not forget to select the DRY CONVEYOR and DRY PATH PLUG options from the DRYER SETUP screen of the operator interface if those device are installed.

AUX DRY CONVEYOR:
If the Dry Conveyor dumps into another conveyor (in addition to the DRY LEG), that must be running before starting Dry Conveyor, we call this device AUX DRY CONVEYOR.

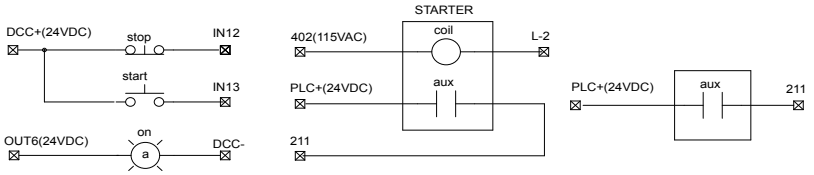
1) You may purchase the optional starter, push buttons, & pilot light installed in the dryer panel, which are connected as shown in the left and center draws.
2) If you have an existing starter system for the AUX Dry Conveyor function, connect the aux contact of your device as shown in the draw to the right.
3) Do not forget to select the AUX DRY CONVEYOR option from the DRYER SETUP screen of the operator interface after the AUX DRY CONVEYOR is installed.



note:located in control panel | note:located in power panel | note:located in power panel

DRY LEG:

1) If an optional DRY LEG STARTER was not provided with your panel, connect your starter as shown in the lest and center draws.
2) If you have an existing DRY LEG STARTER with a separate control, you must provide either a N.O. aux contact from your starter or a leg monitor contact that closes when the leg is running OK. Connect the contact as shown in the draw to the right.
3) Do not forget to select the DRY LEG option from the DRYER SETUP screen of the operator interface after the DRY LEG is installed.

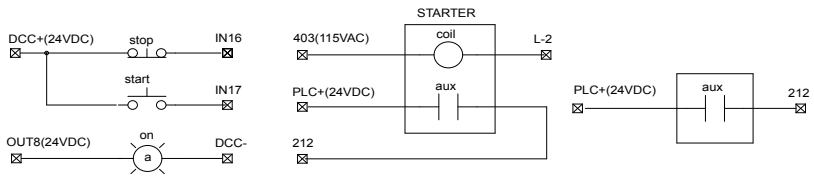


note:located in control panel | note:located in power panel | note:located in power panel

TOP DRY CONVEYOR:

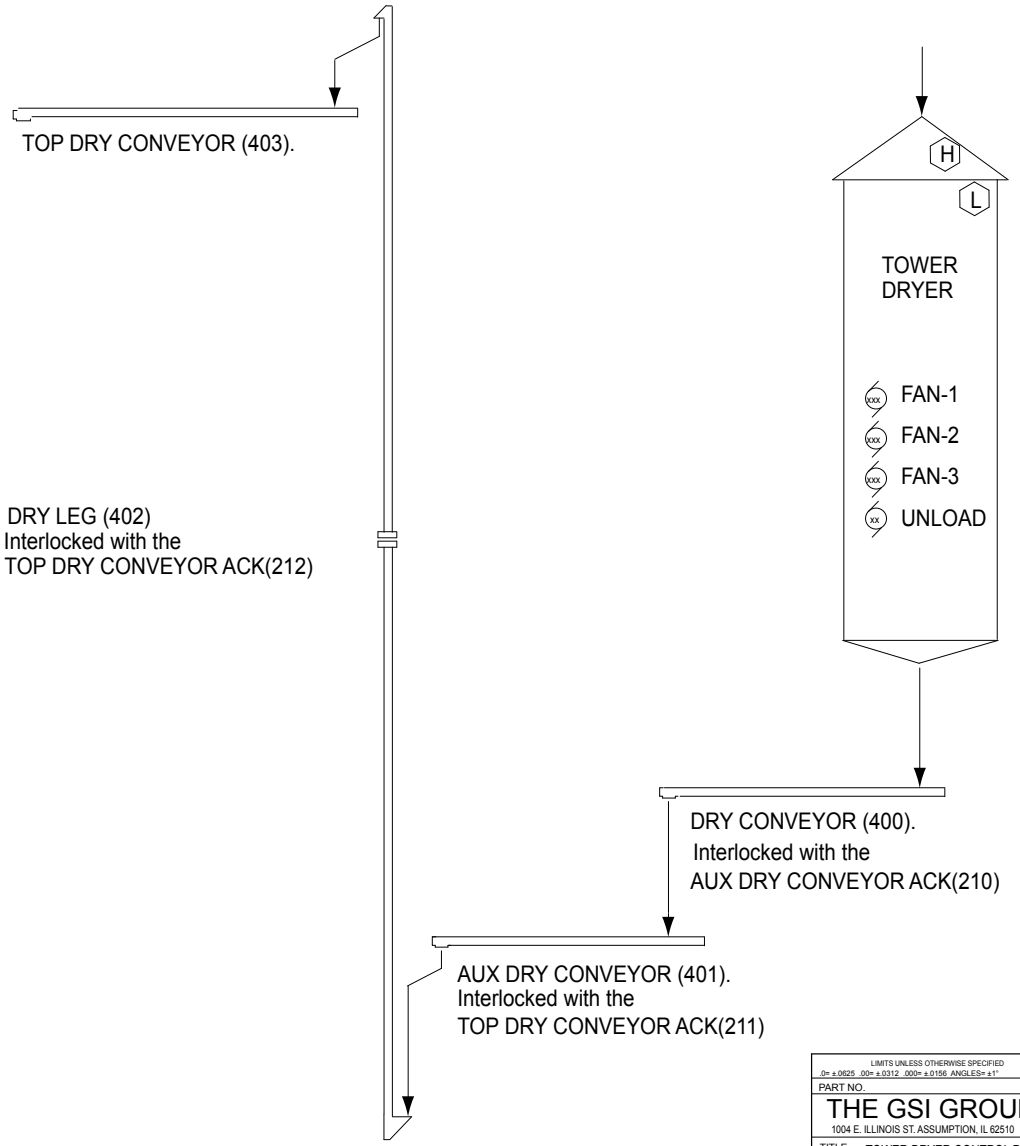
If there is another conveyor after the Dry Leg, we call this device TOP DRY CONVEYOR.

1) You may purchase the optional starter, push buttons, & pilot light installed in the dryer panel, which are connected as shown in the left and center draws.
2) If you have an existing starter system for the Top Dry Conveyor function, connect aux contact of your device as shown in the draw to the right.
3) Do not forget to select the TOP DRY CONVEYOR from the DRYER SETUP screen of the operator interface after the TOP DRY CONVEYOR is installed.



note:located in control panel | note:located in power panel | note:located in power panel

THE DRY PATH



LIMITS UNLESS OTHERWISE SPECIFIED
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PART NO.

THE GSI GROUP
1004 E. ILLINOIS ST. ASSUMPTION, IL 62510

TITLE: TOWER DRYER CONTROL PANEL WIRING DIAGRAM

MAT'L DESC. | P/N

DWG BY	DATE	DWG NO.
QL	04-10-04	2004XX-17
SCALE	SHEET 17 OF 18	

COMPONENT MANUALS

COMPONENT MANUALS

I. AC FREQUENCY DRIVE
II. MAXON BURNER
III. GAS CONTROL VALVE
IV. GAS SHUT-OFF VALVE
V. GEARBOXES
VI. MODUTROL MOTOR
VII. GAS REGULATORS
VIII. ASCO PILOT VALVE
IX. PROTECTOFIER

I

COMPONENT MANUALS AC FREQUENCY DRIVE

PowerFlex 4 Adjustable Frequency AC Drive

FRN 3.xx

This Quick Start guide summarizes the basic steps needed to install, start-up and program the PowerFlex 4 Adjustable Frequency AC Drive. **The information provided Does Not replace the User Manual and is intended for qualified drive service personnel only.**
For detailed PowerFlex 4 information including EMC instructions, application considerations and related precautions refer to the PowerFlex 4 *User Manual*, Publication 22A-UM001… on the CD supplied with the drive or at **www.ab.com/manuals/dr.**

General Precautions

ATTENTION: The drive contains high voltage capacitors which take time to discharge after removal of mains supply. Before working on drive, ensure isolation of mains supply from line inputs [R, S, T (L1, L2, L3)]. Wait three minutes for capacitors to discharge to safe voltage levels. Failure to do so may result in personal injury or death.

Darkened display LEDs is not an indication that capacitors have discharged to safe voltage levels.

ATTENTION: Equipment damage and/or personal injury may result if parameter A092 [Auto Rstrt Tries] or A094 [Start At PowerUp] is used in an inappropriate application. Do not use this function without considering applicable local, national and international codes, standards, regulations or industry guidelines.

ATTENTION: Only qualified personnel familiar with adjustable frequency AC drives and associated machinery should plan or implement the installation, start-up and subsequent maintenance of the system. Failure to comply may result in personal injury and/or equipment damage.

ATTENTION: This drive contains ESD (Electrostatic Discharge) sensitive parts and assemblies. Static control precautions are required when installing, testing, servicing or repairing this assembly. Component damage may result if ESD control procedures are not followed. If you are not familiar with static control procedures, reference A-B publication 8000-4.5.2, “Guarding Against Electrostatic Damage” or any other applicable ESD protection handbook.

ATTENTION: An incorrectly applied or installed drive can result in component damage or a reduction in product life. Wiring or application errors, such as, undersizing the motor, incorrect or inadequate AC supply, or excessive ambient temperatures may result in malfunction of the system.

Mounting Considerations

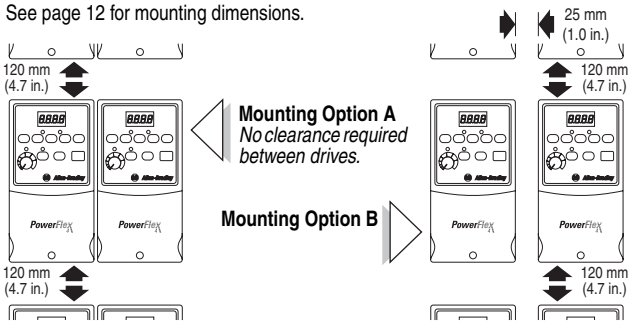
- Mount the drive upright on a flat, vertical and level surface.
  - Install on 35 mm DIN Rail.
    or
  - Install with screws.

Minimum Panel Thickness	Screw Size	Mounting Torque
1.9 mm (0.0747 in.)	M4 (#8-32)	1.56-1.96 N-m (14-17 lb.-in.)

- Protect the cooling fan by avoiding dust or metallic particles.
- Do not expose to a corrosive atmosphere.
- Protect from moisture and direct sunlight.

Minimum Mounting Clearances

See page 12 for mounting dimensions.

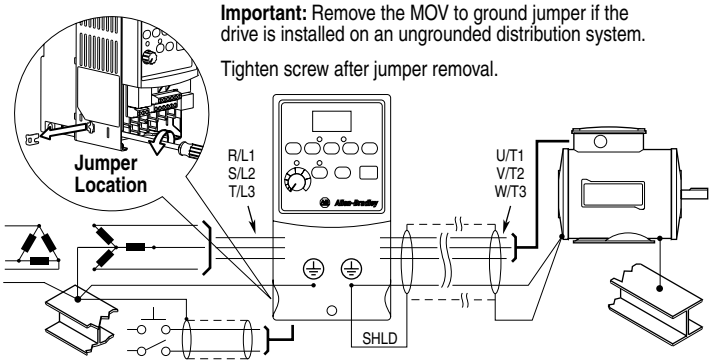


Ambient Operating Temperatures

Ambient Temperature		Enclosure Rating	Minimum Mounting Clearances
Minimum	Maximum		
-10°C (14°F)	40°C (104°F)	IP 20/Open Type	Use Mounting Option A
		IP 30/NEMA 1/UL Type 1(1)	Use Mounting Option B
	50°C (122°F)	IP 20/Open Type	Use Mounting Option B

(1) Rating requires installation of the PowerFlex 4 IP 30/NEMA 1/UL Type 1 option kit.

General Grounding Requirements



Important: Remove the MOV to ground jumper if the drive is installed on an ungrounded distribution system.

Tighten screw after jumper removal.

CE Conformity

Refer to the PowerFlex 4 *User Manual* on the CD supplied with the drive for details on how to comply with the Low Voltage (LV) and Electromagnetic Compatibility (EMC) Directives.

Specifications, Fuses and Circuit Breakers

Drive Ratings

Catalog Number	Output Ratings		Input Ratings			Branch Circuit Protection			Power Dissipation
	kW (HP)	*Amps*	*Voltage Range*	*kVA*	*Amps*	*Fuses*	*140M Motor Protectors (2)*	*Contactors*	*IP20 Open Watts*
100 - 120V AC (±10%) – 1-Phase Input, 0 - 230V 3-Phase Output									
22A-V1P5N104	0.2 (0.25)	1.5	90-126	0.75	6.0	10	140M-C2E-C10	100-C09	25
22A-V2P3N104	0.4 (0.5)	2.3	90-126	1.15	9.0	15	140M-C2E-C16	100-C12	30
22A-V4P5N104	0.75 (1.0)	4.5	90-126	2.25	18.0	30	140M-D8E-C20	100-C23	50
22A-V6P0N104	1.1 (1.5)	6.0	90-126	3.0	24.0	40	140M-D8E-C25	100-C37	70
200 - 240V AC (±10%) – 1-Phase(1) Input, 0 - 230V 3-Phase Output, NO BRAKE									
22A-A1P4N103	0.2 (0.25)	1.4	180-265	0.7	3.2	6	140M-C2E-B40	100-C09	25
22A-A2P1N103	0.4 (0.5)	2.1	180-265	1.05	5.3	10	140M-C2E-B63	100-C09	30
22A-A3P6N103	0.75 (1.0)	3.6	180-265	1.8	9.2	15	140M-C2E-C16	100-C12	50
22A-A6P8N103	1.5 (2.0)	6.8	180-265	3.4	14.2	25	140M-C2E-C16	100-C16	75
22A-A9P6N103	2.2 (3.0)	9.6	180-265	4.8	19.6	30	140M-D8E-C25	100-C23	100
200 - 240V AC (±10%) – 1-Phase(1) Input, 0 - 230V 3-Phase Output									
22A-A1P5N104	0.2 (0.25)	1.5	180-265	0.75	5.0	10	140M-C2E-B63	100-C09	25
22A-A2P3N104	0.4 (0.5)	2.3	180-265	1.15	6.0	10	140M-C2E-B63	100-C09	30
22A-A4P5N104	0.75 (1.0)	4.5	180-265	2.25	10.0	15	140M-C2E-C16	100-C12	50
22A-A8P0N104	1.5 (2.0)	8.0	180-265	4.0	18.0	30	140M-D8E-C20	100-C23	80
200 - 240V AC (±10%) – 3-Phase Input, 0 - 230V 3-Phase Output									
22A-B1P5N104	0.2 (0.25)	1.5	180-265	0.75	1.8	3	140M-C2E-B25	100-C09	25
22A-B2P3N104	0.4 (0.5)	2.3	180-265	1.15	2.5	6	140M-C2E-B40	100-C09	30
22A-B4P5N104	0.75 (1.0)	4.5	180-265	2.25	5.2	10	140M-C2E-C10	100-C09	50
22A-B8P0N104	1.5 (2.0)	8.0	180-265	4.0	9.5	15	140M-C2E-C16	100-C12	80
22A-B012N104	2.2 (3.0)	12.0	180-265	5.5	15.5	25	140M-C2E-C16	100-C16	115
22A-B017N104	3.7 (5.0)	17.5	180-265	8.6	21.0	35	140M-F8E-C25	100-C23	165
380 - 480V AC (±10%) – 3-Phase Input, 0 - 460V 3-Phase Output									
22A-D1P4N104	0.4 (0.5)	1.4	340-528	1.4	1.8	3	140M-C2E-B25	100-C09	30
22A-D2P3N104	0.75 (1.0)	2.3	340-528	2.3	3.2	6	140M-C2E-B40	100-C09	40
22A-D4P0N104	1.5 (2.0)	4.0	340-528	4.0	5.7	10	140M-C2E-B63	100-C09	60
22A-D6P0N104	2.2 (3.0)	6.0	340-528	5.9	7.5	15	140M-C2E-C10	100-C09	90
22A-D8P7N104	3.7 (5.0)	8.7	340-528	8.6	9.0	15	140M-C2E-C16	100-C16	145

Input/Output Ratings

Output Frequency: 0-240 Hz (Programmable)

Efficiency: 97.5% (Typical)

Approvals

UL508C, CSA 22.2 No. 14

EMC Directive 89/336/EEC, LV Dir. 73/23/EEC
LV: EN 50178
EMC: EN 61800-3

Digital Control Inputs (Input Current = 6mA)

SRC (Source) Mode:
18-24V = ON
0-6V = OFF

SNK (Sink) Mode:
0-6V = ON
18-24V = OFF

Analog Control Inputs

4-20mA Analog: 250 ohm input impedance

0-10V DC Analog: 100k ohm input impedance

External Pot: 1-10k ohms, 2 Watt minimum

Control Output (Programmable Output, form C relay)

Resistive Rating: 3.0A at 30V DC, 125V AC and 240V AC

Inductive Rating: 0.5A at 30V DC, 125V AC, and 240V AC

Recommended Fuses and Circuit Breakers

Fuse: UL Class J, CC, T or Type BS88; 600V (550V) or equivalent. *Circuit Breakers:* HMCP or Bulletin 140U or equivalent.

Protective Features

Motor Protection: I^2t overload protection - 150% for 60 Secs, 200% for 3 Secs (Provides Class 10 protection)

Overcurrent: 200% hardware limit, 300% instantaneous fault

Over Voltage:
100-120V AC Input – Trip occurs at 405V DC bus voltage (equivalent to 150V AC incoming line)
200-240V AC Input – Trip occurs at 405V DC bus voltage (equivalent to 290V AC incoming line)
380-460V AC Input – Trip occurs at 810V DC bus voltage (equivalent to 575V AC incoming line)

Under Voltage:
100-120V AC Input – Trip occurs at 210V DC bus voltage (equivalent to 75V AC incoming line)
200-240V AC Input – Trip occurs at 210V DC bus voltage (equivalent to 150V AC incoming line)
380-480V AC Input – Trip occurs at 390V DC bus voltage (equivalent to 275V AC incoming line)

Control Ride Through: Minimum ride through is 0.5 Secs - typical value 2 Secs

Faultless Power Ride Through: 100 milliseconds

Dynamic Braking

Internal brake IGBT included with all ratings except No Brake versions. Refer to Appendix B of the PowerFlex 4 *User Manual* on CD for ordering information.

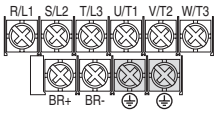
(1) 200-240V AC - 1-Phase drives are also available with an integral EMC filter. Catalog suffix changes from N103 to N113 and N104 to N114.

(2) Refer to the Bulletin 140M Motor Protectors *Selection Guide*, publication 140M-SG001… to determine the frame and breaking capacity required for your application.

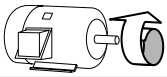
Power Wiring

Power Wire Rating	Recommended Copper Wire
Unshielded 600V, 75°C (167°F) THHN/THWN	15 Mils insulated, dry location
Shielded 600V, 75°C or 90°C (167°F or 194°F) RHH/RHW-2	Belden 29501-29507 or equivalent
Shielded Tray rated 600V, 75°C or 90°C (167°F or 194°F) RHH/RHW-2	Shawflex 2ACD/3ACD or equivalent

Power Terminal Block (A Frame Shown)



Terminal	Description
R/L1, S/L2	1-Phase Input
R/L1, S/L2, T/L3	3-Phase Input
U/T1	To Motor U/T1
V/T2	To Motor V/T2
W/T3	To Motor W/T3
BR+, BR-	Dynamic Brake Resistor Connection [0.75 kW (1 HP) ratings and higher]
⏚	Safety Ground - PE

= 

Switch any two motor leads to change forward direction.

Power Terminal Block Specifications

Frame	Maximum Wire Size (1)	Minimum Wire Size (1)	Torque
A	3.3 mm^2 (12 AWG)	0.8 mm^2 (18 AWG)	1.7-2.2 N-m (16-19 lb.-in.)
B	5.3 mm^2 (10 AWG)	1.3 mm^2 (16 AWG)	

(1) Maximum/minimum sizes that the terminal block will accept - these are not recommendations.

Input Power Conditions

Input Power Condition	Corrective Action
Low Line Impedance (less than 1% line reactance)	• Install Line Reactor(2) • or Isolation Transformer
Greater than 120 kVA supply transformer	
Line has power factor correction capacitors	
Line has frequent power interruptions	
Line has intermittent noise spikes in excess of 6000V (lightning)	
Phase to ground voltage exceeds 125% of normal line to line voltage	• Remove MOV jumper to ground. • or Install Isolation Transformer with grounded secondary if necessary.
Ungrounded Distribution System	

(2) Refer to Appendix B of the PowerFlex 4 *User Manual* on CD for accessory ordering information.

I/O Wiring Recommendations(3)

Wire Type(s)	Description	Minimum Insulation Rating
Belden 8760/9460 (or equiv.)	0.8 mm^2 (18 AWG), twisted pair, 100% shield with drain.	300V 60 degrees C (140 degrees F)
Belden 8770 (or equiv.)	0.8 mm^2 (18 AWG), 3 conductor, shielded for remote pot only.	

(3) If the wires are short and contained within a cabinet which has no sensitive circuits, the use of shielded wire may not be necessary, but is always recommended.

I/O Terminal Block Specifications

Maximum Wire Size (4)	Minimum Wire Size (4)	Torque
1.3 mm^2 (16 AWG)	0.13 mm^2 (26 AWG)	0.5-0.8 N-m (4.4-7 lb.-in.)

(4) Maximum / minimum that the terminal block will accept - these are not recommendations.

Refer to the PowerFlex 4 *User Manual* on CD for maximum power and control cable length recommendations

Control Terminal Block

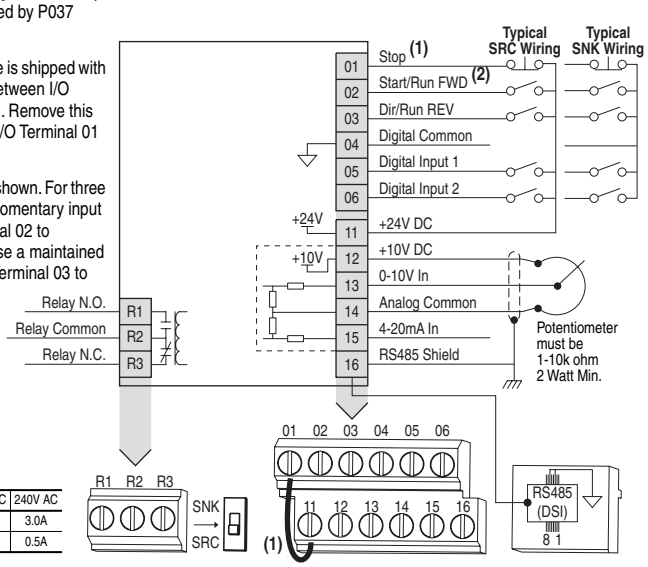
(1) Important: I/O Terminal 01 is always a coast to stop input except when P036 [Start Source] is set to "3-Wire" control. In three wire control, I/O Terminal 01 is controlled by P037 [Stop Mode]. All other stop sources are controlled by P037 [Stop Mode].

P036 [Start Source]	Stop	I/O Terminal 01 Stop
Keypad	Per P037	Coast
3-Wire	Per P037	Per P037
2-Wire	Per P037	Coast
RS485 Port	Per P037	Coast

Refer to the PowerFlex 4 *User Manual* on CD for detailed I/O wiring examples.

Important: The drive is shipped with a jumper installed between I/O Terminals 01 and 11. Remove this jumper when using I/O Terminal 01 as a stop input.

(2) Two wire control shown. For three wire control use a momentary input on I/O Terminal 02 to command a start. Use a maintained input for I/O Terminal 03 to change direction.



	30V DC	125V AC	240V AC
Resistive	3.0A	3.0A	3.0A
Inductive	0.5A	0.5A	0.5A

No.	Signal	Default	Description	Param.
R1	Relay N.O.	Fault	Normally open contact for output relay.	A055
R2	Relay Common	–	Common for output relay.	
R3	Relay N.C.	Fault	Normally closed contact for output relay.	A055
Sink/Source DIP Switch		Source (SRC)	Inputs can be wired as Sink (SNK) or Source (SRC) via DIP Switch setting.	
01	Stop(1)	Coast	The factory installed jumper or a normally closed input must be present for the drive to start.	P036(1)
02	Start/Run FWD	Not Active	Command comes from the integral keypad by default. To disable reverse operation, see A095 [Reverse Disable].	P036, P037
03	Direction/Run REV	Not Active		P036, P037, A095
04	Digital Common	–	For digital inputs. Electronically isolated with digital inputs from analog I/O.	
05	Digital Input 1	Preset Freq	Program with A051 [Digital In1 Sel].	A051
06	Digital Input 2	Preset Freq	Program with A052 [Digital In2 Sel].	A052
11	+24V DC	–	Drive supplied power for digital inputs. Maximum output current is 100mA.	
12	+10V DC	–	Drive supplied power for 0-10V external potentiometer. Maximum output current is 15mA.	P038
13	0-10V In(3)	Not Active	For external 0-10V input supply (input impedance = 100k ohm) or potentiometer wiper.	P038
14	Analog Common	–	For 0-10V In or 4-20mA In. Electronically isolated with analog inputs from digital I/O.	
15	4-20mA In(3)	Not Active	For external 4-20mA input supply (input impedance = 250 ohm).	P038
16	RS485 (DSI) Shield	–	Terminal should be connected to safety ground - PE when using the RS485 (DSI) communications port.	

(3) Only one analog frequency source may be connected at a time. If more than one reference is connected at the same time, an undetermined frequency reference will result.

Prepare For Drive Start-Up

ATTENTION: Power must be applied to the drive to perform the following start-up procedures. Some of the voltages present are at incoming line potential. To avoid electric shock hazard or damage to equipment, only qualified service personnel should perform the following procedure. Thoroughly read and understand the procedure before beginning. If an event does not occur while performing this procedure, **Do Not Proceed**. **Remove All Power** including user supplied control voltages. User supplied voltages may exist even when main AC power is not applied to the drive. Correct the malfunction before continuing.

Before Applying Power to the Drive

❑ **1.** Confirm that all inputs are connected to the correct terminals and are secure.

❑ **2.** Verify that AC line power at the disconnect device is within the rated value of the drive.

❑ **3.** Verify that any digital control power is 24 volts.

❑ **4.** Verify that the Sink (SNK)/Source (SRC) Setup DIP Switch is set to match your control wiring scheme. See page 5 for location.

Important: The default control scheme is Source (SRC). The Stop terminal is jumpered (I/O Terminals 01 and 11) to allow starting from the keypad. If the control scheme is changed to Sink (SNK), the jumper must be removed from I/O Terminals 01 and 11 and installed between I/O Terminals 01 and 04.

❑ **5.** Verify that the Stop input is present or the drive will not start.

Important: If I/O Terminal 01 is used as a stop input, the jumper between I/O Terminals 01 and 11 must be removed.

Applying Power to the Drive

❑ **6.** Apply AC power and control voltages to the drive.

❑ **7.** Familiarize yourself with the integral keypad features (see next page) before setting any Program Group parameters.

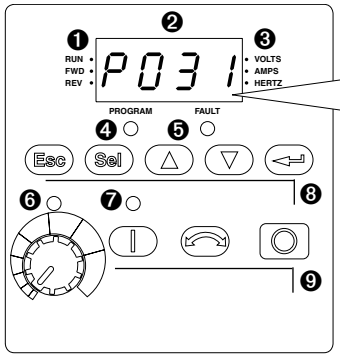
Start, Stop, Direction and Speed Control

Factory default parameter values allow the drive to be controlled from the integral keypad. No programming is required to start, stop, change direction and control speed directly from the integral keypad.

Important: To disable reverse operation, see A095 [Reverse Disable].

If a fault appears on power up, refer to page 11 for an explanation of the fault code. For complete troubleshooting information, refer to the PowerFlex 4 *User Manual* on the CD supplied with the drive.

Integral Keypad



Menu	Description
d	**Display Group (View Only)** Consists of commonly viewed drive operating conditions.
P	**Basic Program Group** Consists of most commonly used programmable functions.
A	**Advanced Program Group** Consists of remaining programmable functions.
F	**Fault Designator** Consists of list of codes for specific fault conditions. Displayed only when fault is present.

No.	LED	LED State	Description
❶	Run/Direction Status	Steady Red	Indicates drive is running and commanded motor direction.
		Flashing Red	Drive has been commanded to change direction. Indicates actual motor direction while decelerating to zero.
❷	Alphanumeric Display	Steady Red	Indicates parameter number, parameter value, or fault code.
		Flashing Red	Single digit flashing indicates that digit can be edited. All digits flashing indicates a fault condition.
❸	Displayed Units	Steady Red	Indicates the units of the parameter value being displayed.
❹	Program Status	Steady Red	Indicates parameter value can be changed.
❺	Fault Status	Flashing Red	Indicates drive is faulted.
❻	Pot Status	Steady Green	Indicates potentiometer on Integral Keypad is active.
❼	Start Key Status	Steady Green	Indicates Start key on Integral Keypad is active. The Reverse key is also active unless disabled by A095 [Reverse Disable].

No.	Key	Name	Description
❽	Esc	Escape	Back one step in programming menu. Cancel a change to a parameter value and exit Program Mode.
	Sel	Select	Advance one step in programming menu. Select a digit when viewing parameter value.
	▲ ▼	Up Arrow Down Arrow	Scroll through groups and parameters. Increase/decrease the value of a flashing digit.
	↵	Enter	Advance one step in programming menu. Save a change to a parameter value.
❾		Potentiometer	Used to control speed of drive. Default is active. Controlled by parameter P038.
		Start	Used to start the drive. Default is active. Controlled by parameter P036.
		Reverse	Used to reverse direction of the drive. Default is active. Controlled by parameters P036 and A095.
		Stop	Used to stop the drive or clear a fault. This key is always active. Controlled by parameter P037.

Viewing and Editing Parameters

The last user-selected Display Group parameter is saved when power is removed and is displayed by default when power is reapplied.

The following is an example of basic integral keypad and display functions. This example provides basic navigation instructions and illustrates how to program the first Program Group parameter.

Step	Key(s)	Example Displays
1. When power is applied, the last user-selected Display Group parameter number is briefly displayed with flashing characters. The display then defaults to that parameter's current value. (Example shows the value of d001 [Output Freq] with the drive stopped.)		
2. Press Esc once to display the Display Group parameter number shown on power-up. The parameter number will flash.	Esc	
3. Press Esc again to enter the group menu. The group menu letter will flash.	Esc	
4. Press the Up Arrow or Down Arrow to scroll through the group menu (d, P and A).	▲ or ▼	
5. Press Enter or Sel to enter a group. The right digit of the last viewed parameter in that group will flash.	↵ or Sel	
6. Press the Up Arrow or Down Arrow to scroll through the parameters that are in the group.	▲ or ▼	
7. Press Enter or Sel to view the value of a parameter. If you do not want to edit the value, press Esc to return to the parameter number.	↵ or Sel	
8. Press Enter or Sel to enter program mode to edit the parameter value. The right digit will flash and the Program LED will illuminate if the parameter can be edited.	↵ or Sel	
9. Press the Up Arrow or Down Arrow to change the parameter value. If desired, press Sel to move from digit to digit or bit to bit. The digit or bit that you can change will flash.	▲ or ▼	
10. Press Esc to cancel a change. The digit will stop flashing, the previous value is restored and the Program LED will turn off. Or Press Enter to save a change. The digit will stop flashing and the Program LED will turn off.	Esc ↵	
11. Press Esc to return to the parameter list. Continue to press Esc to back out of the programming menu. If pressing Esc does not change the display, then d001 [Output Frequency] is displayed. Press Enter or Sel to enter the group menu.	Esc	

Display Group Parameters

No.	Parameter	Min/Max	Display/Options			
d001	[Output Freq]	0.0/[Maximum Freq]	0.1 Hz			
d002	[Commanded Freq]	0.0/[Maximum Freq]	0.1 Hz			
d003	[Output Current]	0.00/(Drive Amps × 2)	0.01 Amps			
d004	[Output Voltage]	0/Drive Rated Volts	1 VAC			
d005	[DC Bus Voltage]	Based on Drive Rating	1 VDC			
d006	[Drive Status]	0/1 (1 = Condition True)	Bit 3 Decelerating	Bit 2 Accelerating	Bit 1 Forward	Bit 0 Running
d007-d009	[Fault x Code]	F2/F122	F1			
d010	[Process Display]	0.00/9999	0.01 – 1			
d012	[Control Source]	0/9	Digit 1 = Speed Command (See P038; 9 = "Jog Freq")		Digit 0 = Start Command (See P036; 9 = "Jog")	
d013	[Contrl In Status]	0/1 (1 = Input Present)	Bit 3 Reserved	Bit 2 Stop Input	Bit 1 Dir/Run REV	Bit 0 Start/Run FWD
d014	[Dig In Status]	0/1 (1 = Input Present)	Bit 3 Reserved	Bit 2 Reserved	Bit 1 Digital In2 Sel	Bit 0 Digital In1 Sel
d015	[Comm Status]	0/1 (1 = Condition True)	Bit 3 Fault Occurred	Bit 2 RS485 Option	Bit 1 Transmitting	Bit 0 Receiving
d016	[Control SW Ver]	1.00/99.99	0.01			
d017	[Drive Type]	1001/9999	1			
d018	[Elapsed Run Time]	0/9999 Hrs	1 = 10 Hrs			
d019	[Testpoint Data]	0/FFFF	1 Hex			
d020	[Analog In 0-10V]	0.0/100.0%	0.1%			
d021	[Analog In 4-20mA]	0.0/100.0%	0.1%			
d024	[Drive Temp]	0/120 degC	1 degC			

Smart Start-Up with Basic Program Group Parameters

The Program Group contains the most commonly used parameters.

◎ = Stop drive before changing this parameter.

No.	Parameter	Min/Max	Display/Options		Default
P031 ◎	[Motor NP Volts]	20/Drive Rated Volts	1 VAC		Based on Drive Rating
	Set to the motor nameplate rated volts.				
P032 ◎	[Motor NP Hertz]	10/240 Hz	1 Hz		60 Hz
	Set to the motor nameplate rated frequency.				
P033	[Motor OL Current]	0.0/(Drive Rated Amps×2)	0.1 Amps		Based on Drive Rating
	Set to the maximum allowable motor current.				
P034	[Minimum Freq]	0.0/240.0 Hz	0.1 Hz		0.0 Hz
	Sets the lowest frequency the drive will output continuously.				
P035 ◎	[Maximum Freq]	0/240 Hz	1 Hz		60 Hz
	Sets the highest frequency the drive will output.				
P036 ◎	[Start Source]	0/5	0 = "Keypad"(1) 1 = "3-Wire" 2 = "2-Wire"	3 = "2-W Lvl Sens" 4 = "2-W Hi Speed" 5 = "Comm Port"	0
	Sets the control scheme used to start the drive. (1) When active, the Reverse key is also active unless disabled by A095 [Reverse Disable].				
P037	[Stop Mode]	0/7	0 = "Ramp, CF"(1) 1 = "Coast, CF"(1) 2 = "DC Brake, CF"(1) 3 = "DCBrkAuto,CF"(1)	4 = "Ramp" 5 = "Coast" 6 = "DC Brake" 7 = "DC BrakeAuto"	0
	Active stop mode for all stop sources [e.g. keypad, run forward (I/O Terminal 02), run reverse (I/O Terminal 03), RS485 port] except as noted below.				
	Important: I/O Terminal 01 is always a coast to stop input except when P036 [Start Source] is set for "3-Wire" control. When in three wire control, I/O Terminal 01 is controlled by P037 [Stop Mode]. (1) Stop input also clears active fault.				
P038	[Speed Reference]	0/5	0 = "Drive Pot" 1 = "InternalFreq" 2 = "0-10V Input"	3 = "4-20mA Input" 4 = "Preset Freq" 5 = "Comm Port"	0
	Sets the source of the speed reference to the drive.				
	Important: When A051 or A052 [Digital Inx Sel] is set to option 2, 4, 5, 6, 13 or 14, and the digital input is active, A051 or A052 will override the speed reference commanded by this parameter. Refer to Chapter 1 of the PowerFlex 4 *User Manual* on CD for details.				
P039	[Accel Time 1]	0.0/600.0 Secs	0.1 Secs		10.0 Secs
	Sets the rate of accel for all speed increases.				
P040	[Decel Time 1]	0.1/600.0 Secs	0.1 Secs		10.0 Secs
	Sets the rate of decel for all speed decreases.				
P041 ◎	[Reset To Defalts]	0/1	0 = "Idle State" 1 = "Reset Defaults"		0
	Resets all parameter values to factory defaults.				

Advanced Group Parameters

No.	Parameter	Min/Max	Display/Options	Default
A051 *I/O Terminal 05* A052 *I/O Terminal 06*	[Digital In1 Sel] [Digital In2 Sel]	0/26	0 = "Not Used" 1 = "Acc 2 & Dec 2" 2 = "Jog" 3 = "Aux Fault" 4 = "Preset Freq" 5 = "Local" 6 = "Comm Port" 7 = "Clear Fault" 8 = "RampStop,CF" 9 = "CoastStop,CF" 10 = "DCInjStop,CF" 11 = "Jog Forward" 12 = "Jog Reverse" 13 = "10V In Ctrl" 14 = "20mA In Ctrl" 26 = "Anlg Invert"	4
A055	[Relay Out Sel]	0/21	0 = "Ready/Fault" 1 = "At Frequency" 2 = "MotorRunning" 3 = "Reverse" 4 = "Motor Overld" 5 = "Ramp Reg" 6 = "Above Freq" 7 = "Above Cur" 8 = "Above DCVolt" 9 = "Retries Exst" 10 = "Above Anlg V" 20 = "ParamControl" 21 = "NonRec Fault"	0
A056	[Relay Out Level]	0.0/9999	0.1	0.0
A067	[Accel Time 2]	0.0/600.0 Secs	0.1 Secs	20.0 Secs
A068	[Decel Time 2]	0.1/600.0 Secs	0.1 Secs	20.0 Secs
A069	[Internal Freq]	0.0/240.0 Hz	0.1 Hz	60.0 Hz
A070 A071 A072 A073	[Preset Freq 0](1) [Preset Freq 1] [Preset Freq 2] [Preset Freq 3]	0.0/240.0 Hz	0.1 Hz	0.0 Hz 5.0 Hz 10.0 Hz 20.0 Hz

(1) To activate [Preset Freq 0] set P038 [Speed Reference] to option 4.

Input State of Digital In 1 (I/O Terminal 05)	Input State of Digital In 2 (I/O Terminal 06)	Frequency Source	Accel / Decel Parameter Used (2)
0	0	[Preset Freq 0]	[Accel Time 1] / [Decel Time 1]
1	0	[Preset Freq 1]	[Accel Time 1] / [Decel Time 1]
0	1	[Preset Freq 2]	[Accel Time 2] / [Decel Time 2]
1	1	[Preset Freq 3]	[Accel Time 2] / [Decel Time 2]

(2) When a Digital Input is set to "Accel 2 & Decel 2", and the input is active, that input overrides the settings in this table.

No.	Parameter	Min/Max	Display/Options	Default
A078	[Jog Frequency]	0.0/[Maximum Freq]	0.1 Hz	10.0 Hz
A079	[Jog Accel/Decel]	0.1/600.0 Secs	0.1 Secs	10.0 Secs
A080	[DC Brake Time]	0.0/90.0 Secs	0.1 Secs	0.0 Secs
A081	[DC Brake Level]	0.0/(Drive Amps × 1.8)	0.1 Amps	Amps × 0.05
A082	[DB Resistor Sel]	0/99	0 = Disabled 1 = Normal RA Res 2 = NoProtection 3-99 = % of Duty Cycle	0
A083	[S Curve %]	0/100%	1%	0% (Disabled)
A084	[Start Boost] Only active when A125 [Torque Perf Mode] is set to 0 "V/Hz".	1/14	Settings in % of base voltage. 0 = "Custom V/Hz" Variable Torque: 1 = "30.0, VT", 2 = "35.0, VT", 3 = "40.0, VT", 4 = "45.0, VT" Constant Torque: 5 = "0.0, no IR", 6 = "0.0", 7 = "2.5, CT", 8 = "5.0, CT", 9 = "7.5, CT", 10 = "10.0, CT", 11 = "12.5, CT", 12 = "15.0, CT", 13 = "17.5, CT", 14 = "20.0, CT"	8 7 (5 HP Drives)
A088	[Maximum Voltage]	20/Rated Volts	1 VAC	Rated Volts
A089	[Current Limit]	0.1/(Drive Amps × 1.8)	0.1 Amps	Amps × 1.5
A090	[Motor OL Select]	0/2	0 = "No Derate" 1 = "Min Derate" 2 = "Max Derate"	0
A091	[PWM Frequency]	2.0/16.0 kHz	0.1 kHz	4.0 kHz
A092	[Auto Rstrt Tries]	0/9	1	0
A093	[Auto Rstrt Delay]	0.0/300.0 Secs	0.1 Secs	1.0 Secs
A094	[Start At PowerUp]	0/1	0 = "Disabled" 1 = "Enabled"	0
A095	[Reverse Disable]	0/1	0 = "Rev Enabled" 1 = "Rev Disabled"	0
A096	[Flying Start En]	0/1	0 = "Disabled" 1 = "Enabled"	0
A097	[Compensation]	0/3	0 = "Disabled" 1 = "Electrical" 2 = "Mechanical" 3 = "Both"	1
A098	[SW Current Trip]	0.0/(Drive Amps × 2)	0.1 Amps	0.0 (Disabled)
A099	[Process Factor]	0.1/999.9	0.1	30.0
A100	[Fault Clear]	0/2	0 = "Ready/Idle" 1 = "Reset Fault" 2 = "Clear Buffer"	0
A101	[Program Lock]	0/1	0 = "Unlocked" 1 = "Locked"	0

No.	Parameter	Min/Max	Display/Options		Default
A102	[Testpoint Sel]	0/FFFF	1 Hex		400
A103	[Comm Data Rate][3]	0/5	0 = "1200" 1 = "2400" 2 = "4800"	3 = "9600" 4 = "19.2K" 5 = "38.4K"	3
A104	[Comm Node Addr][3]	1/247	1		100
A105	[Comm Loss Action]	0/3	0 = "Fault" 1 = "Coast to Stop"	2 = "Stop" 3 = "Continu Last"	0
A106	[Comm Loss Time]	0.1/60.0	0.1		5.0
A107	[Comm Format][3]	0/5	0 = "RTU 8-N-1" 1 = "RTU 8-E-1" 2 = "RTU 8-O-1"	3 = "RTU 8-N-2" 4 = "RTU 8-E-2" 5 = "RTU 8-O-2"	0
A110	[Anlg In 0-10V Lo]	0.0/100.0%	0.1%		0.0%
A111	[Anlg In 0-10V Hi]	0.0/100.0%	0.1%		100.0%
A112	[Anlg In4-20mA Lo]	0.0/100.0%	0.1%		0.0%
A113	[Anlg In4-20mA Hi]	0.0/100.0%	0.1%		100.0%
A114	[Slip Hertz @ FLA]	0.0/10.0 Hz	0.1 Hz		2.0 Hz
A115	[Process Time Lo]	0.00/99.99	0.01		0.00
A116	[Process Time Hi]	0.00/99.99	0.01		0.00

(3) Power to drive must be cycled before any changes will affect drive operation.

Fault Codes

To clear a fault, press the Stop key, cycle power or set A100 [Fault Clear] to 1 or 2.

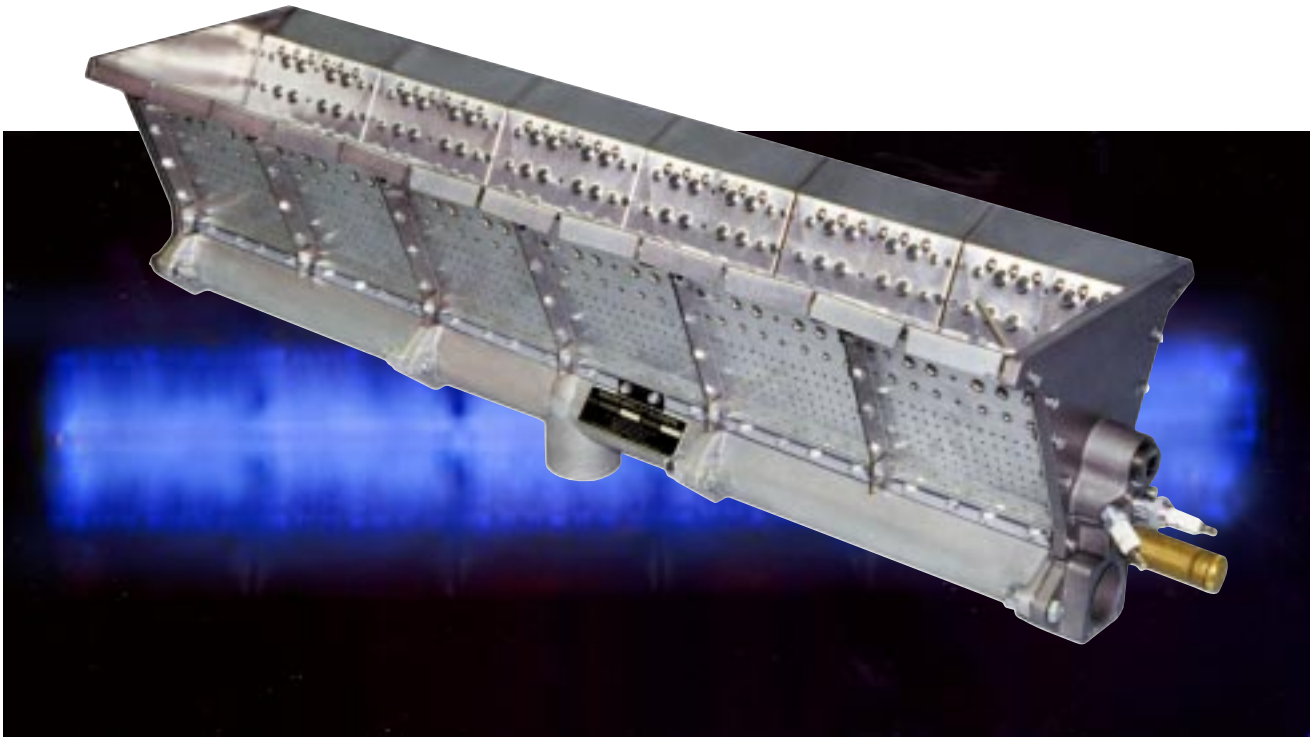
No.	Fault	Description
F2	Auxiliary Input(1)	Check remote wiring.
F3	Power Loss	Monitor the incoming AC line for low voltage or line power interruption.
F4	UnderVoltage(1)	Monitor the incoming AC line for low voltage or line power interruption.
F5	OverVoltage(1)	Monitor the AC line for high line voltage or transient conditions. Bus overvoltage can also be caused by motor regeneration. Extend the decel time or install dynamic brake option.
F6	Motor Stalled(1)	Increase [Accel Time x] or reduce load so drive output current does not exceed the current set by parameter A089 [Current Limit].
F7	Motor Overload(1)	An excessive motor load exists. Reduce load so drive output current does not exceed the current set by parameter P033 [Motor OL Current].
F8	Heatsink OvrTmp(1)	Check for blocked or dirty heat sink fins. Verify that ambient temperature has not exceeded 40°C (104°F) for IP 30/NEMA 1/UL Type 1 installations or 50°C (122°F) for Open type installations. Check fan.
F12	HW OverCurrent(1)	Check programming. Check for excess load, improper DC boost setting, DC brake volts set too high or other causes of excess current.
F13	Ground Fault	Check the motor and external wiring to the drive output terminals for a grounded condition.
F33	Auto Rstrt Tries	Correct the cause of the fault and manually clear.
F38	Phase U to Gnd	Check the wiring between the drive and motor. Check motor for grounded phase. Replace drive if fault cannot be cleared.
F39	Phase V to Gnd	
F40	Phase W to Gnd	
F41	Phase UV Short	Check the motor and drive output terminal wiring for a shorted condition. Replace drive if fault cannot be cleared.
F42	Phase UW Short	
F43	Phase VW Short	
F48	Params Defaulted	The drive was commanded to write default values to EEPROM. Clear the fault or cycle power to the drive. Program the drive parameters as needed.
F63	SW OverCurrent(1)	Check load requirements and A098 [SW Current Trip] setting.
F64	Drive Overload	Reduce load or extend Accel Time.
F70	Power Unit	Cycle power. Replace drive if fault cannot be cleared.
F81	Comm Loss	If adapter was not intentionally disconnected, check wiring to the port. Replace wiring, port expander, adapters or complete drive as required. Check connection. An adapter was intentionally disconnected. Turn off using A105 [Comm Loss Action].
F100	Parameter Checksum	Restore factory defaults.
F122	I/O Board Fail	Cycle power. Replace drive if fault cannot be cleared.

(1) Auto-Reset/Run type fault. Configure with parameters A092 and A093.

II

COMPONENT MANUALS MAXON BURNER

Series NP-LE AIRFLO® Burners



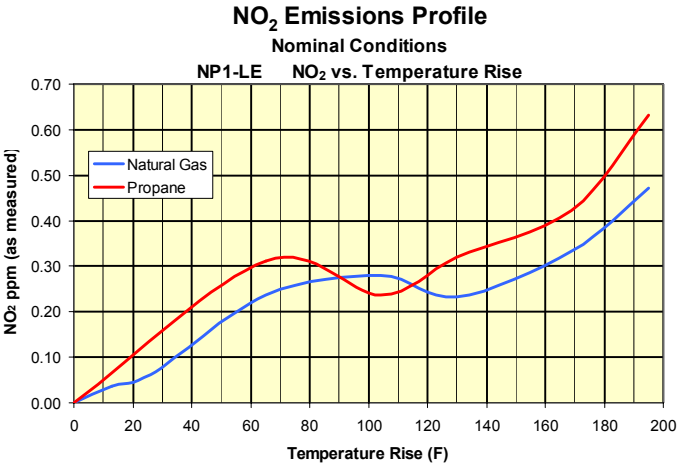
- Designed for direct-fired make-up air and process applications
- Improved emissions performance over Maxon's standard NP AIRFLO® Burner, with significantly lower levels of CO and NO_2
- Higher capacity - up to 1,000,000 Btu/hr/ft
- Shorter flame length
- Easily meets ANSI/CSA standards
- Available in low pressure version and corrosion-resistant materials

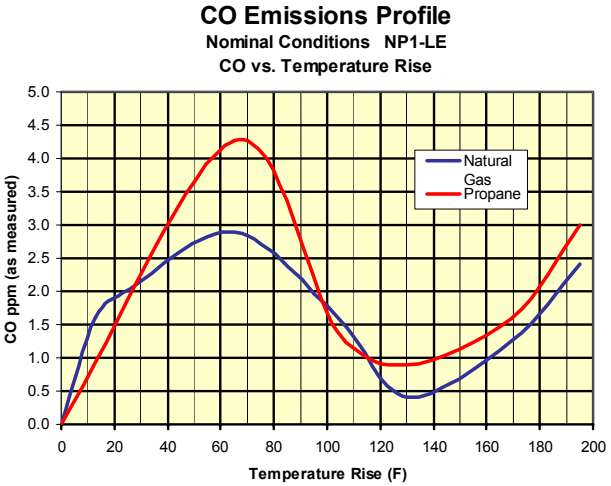
MAXON®
CORPORATION 201 East 18th Street, P.O. Box 2068, Muncie, Indiana, 47307-0068. Phone: (765) 284-3304. Fax (765) 286-8394

Design and Application Details

Specifications

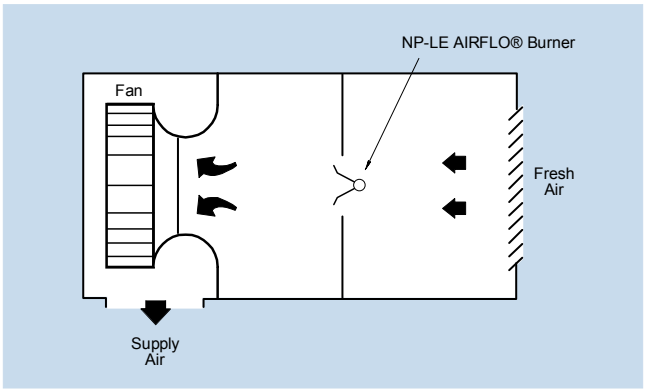
Input Rating	Up to 1,000,000 Btu/hr/ft
Airstream Profile Differential Pressure	0.3 to 1.0 "wc
Pilot Capacity	25,000 Btu/hr @ 4"-6" wc
Burner Turndown	30:1
Maximum Upstream Temperature	600°F cast iron; 450°F aluminum
Maximum Downstream Temperature	1000°F cast iron; 850°F aluminum
Maximum Temperature Rise	760°F
Minimum Upstream Oxygen	18% O_2
Burner Bodies	NP1-LE Cast iron and aluminum NP2-LE Cast iron
Burner Section Configurations	6" Straight 12" Straight 12" Straight with Back Inlet 6" x 12" Tee 6" x 6" Elbow (cast iron only) 36" Back Inlet (12" x 12" H-configuration)
Mixing Plates	430 Stainless Steel
Assembly Material Availability	***NP1-LE:*** - **Standard** - Cast Iron Body, Cast Iron End Plates - **AL** - Aluminum Body, Cast Iron End Plates - **ALSS** - Aluminum Body & Back-up Bars, Nickle Plated End Plates, Stainless Steel Fasteners ***NP2-LE:*** - **Standard** - Cast Iron Body, Cast Iron End Plates
Accessories	Spark Ignitor UV Flame Scanner Connection Flame Rod Adjustable Pilot Orifice Division Plate External Mounting Assemblies



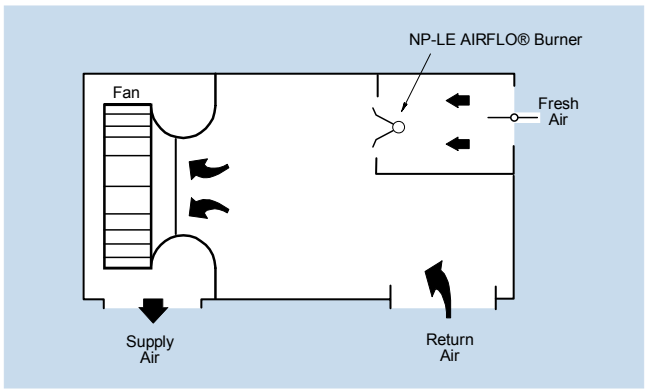


Typical Applications for Maxon Series NP-LE AIRFLO® Burners

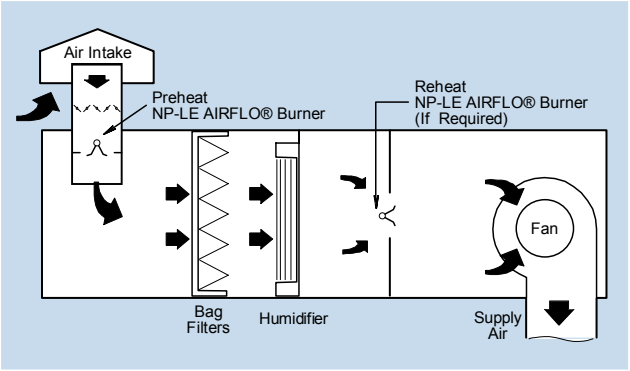
Packaged Make-up Air Systems with 100% Outside Air



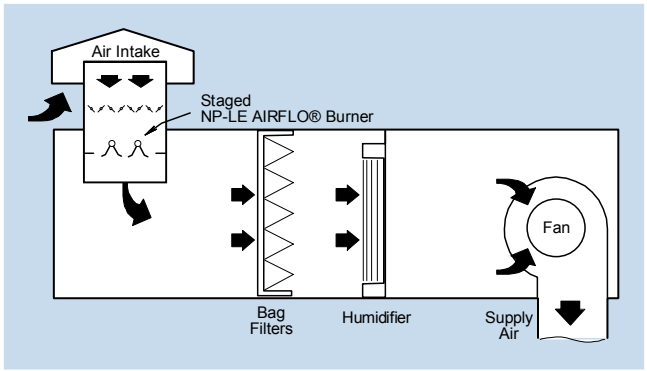
Packaged Make-up Air Systems with Partially Recirculated Air



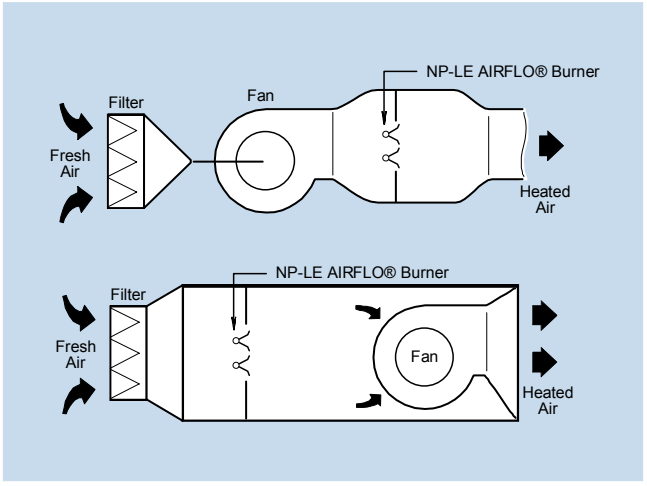
Single-stage Burner Heated Paint Spray Booths with Re-heat Option



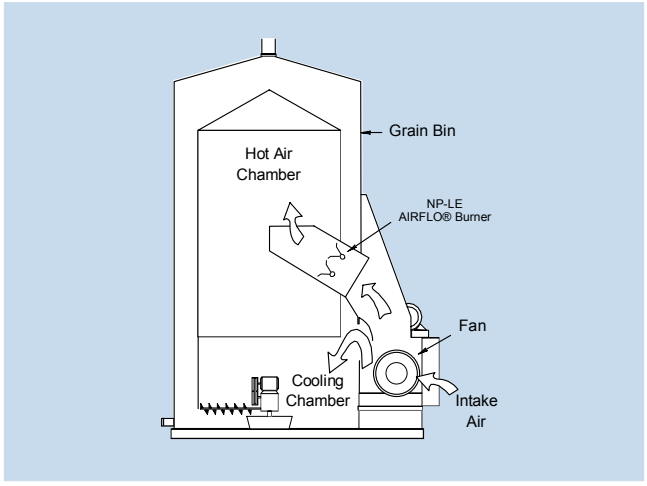
Humidity Controlled, 2-stage Burner Heated Paint Spray Booths



Drying, Baking & Curing Operations

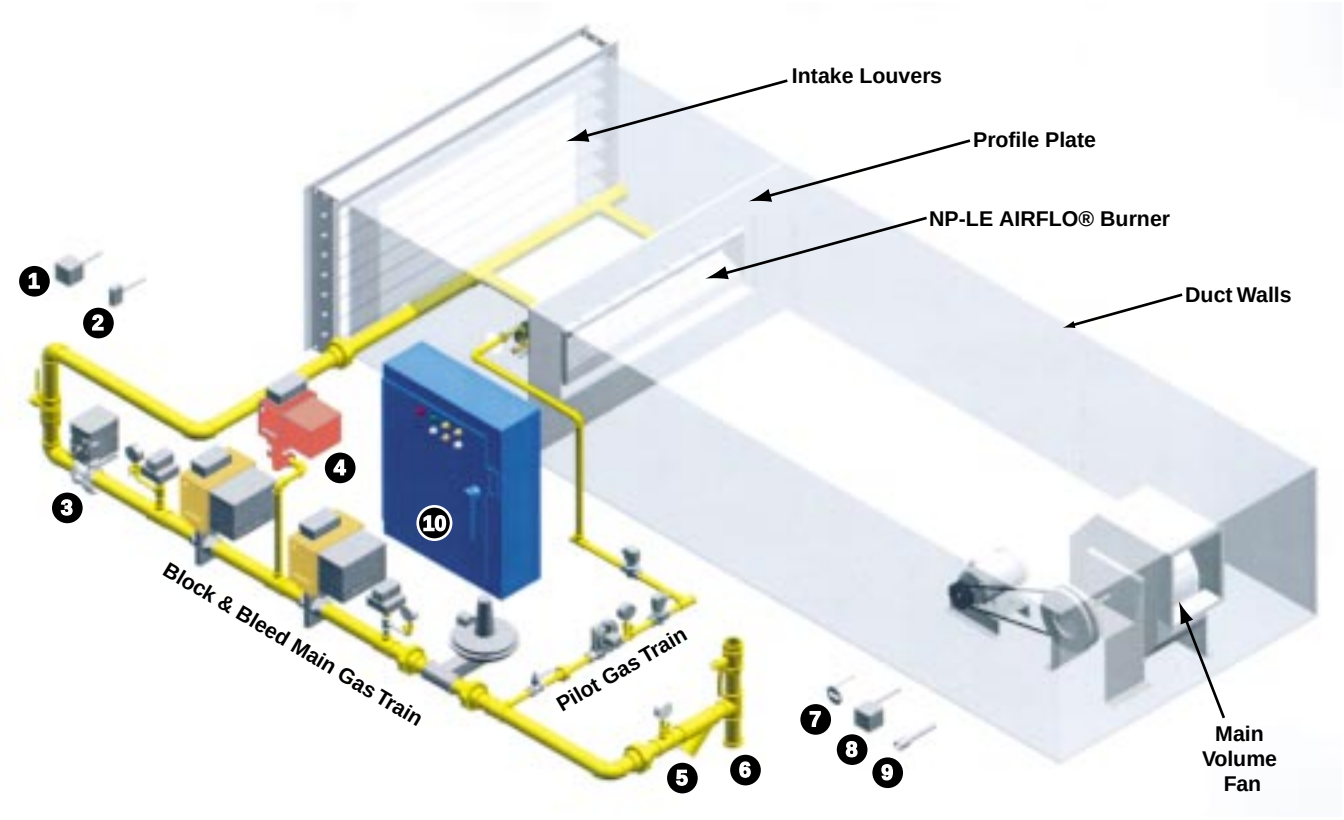


Grain Dryers



Design and Application Details

System components normally used in conjunction with a Maxon NP-LE AIRFLO® Burner application



Legend:

Item Number	Description
1	Outside thermostat
2	Intake high temperature limit switch
3	Control valve
4	Vent valve
5	Strainer
6	Drip leg
7	Differential air switch
8	High temperature switch
9	Discharge air thermostat
10	Sequencing Control Panel

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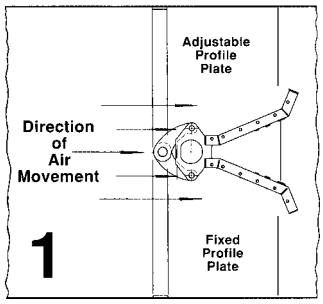
Installation Instructions

General

Important: Do not discard packing material until all loose items are accounted for.

Avoid bending or damaging the steel mixing plates of your Series NP-LE AIRFLO® Burner during uncrating and installation.

These burners are used for the heating of fresh air in motion. Mount the burners so they fire parallel to and in the same direction as the movement of the air (see **sketch 1** at right).



Velocity and flow of air at operating temperature must be uniform. Minimum silhouette profile plates of 6" should be installed in duct to completely surround burner assembly.

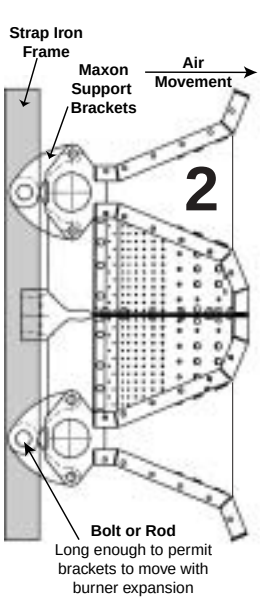
Supports

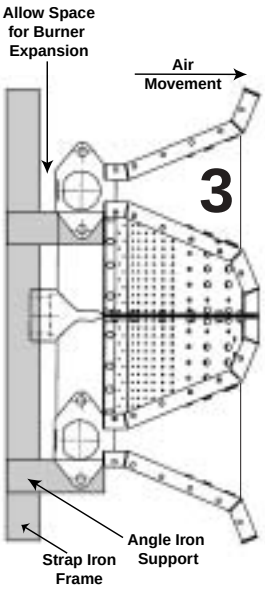
Series NP-LE AIRFLO® Burner assemblies must be adequately supported and positioned.

Avoid rigid mounting. Burner assembly expands and contracts with temperature variations.

Maintain smooth, even air flow over the burner by designing supports to provide minimum interference, deflection and turbulence.

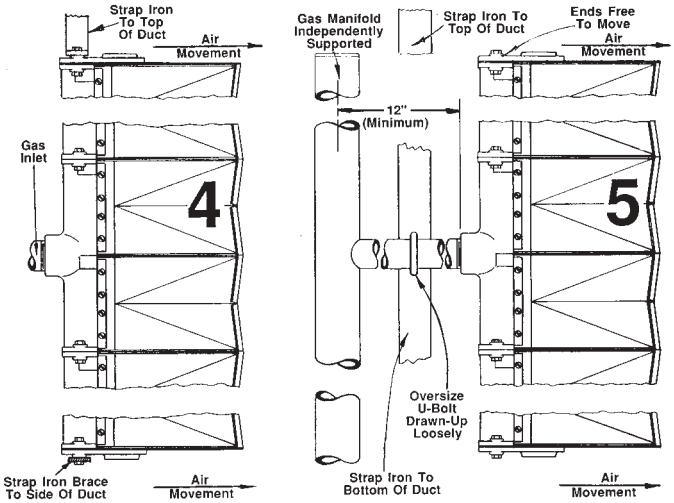
The sketches below show typical installation and support methods:





Sketch 2 shows the burner suspended from a strap iron frame using Maxon USB support brackets. Note that rigid mounting is avoided by the bracket hole which slips loosely over a bolt or steel rod attached to the support. Gas piping would need independent support.

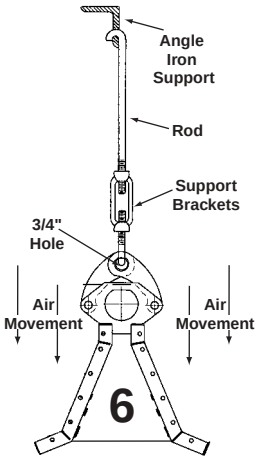
Sketch 3 shows the burner assembly resting upon angle iron brackets and not attached to them in any way. Be sure the angle iron supports allow the burner flanges to expand and contract. Gas manifolding would be independently supported and prevent forward movement of the burner.



Sketch 4 shows simple strap iron used to support the burner. Note that narrow edge of strap faces air flow to avoid undue turbulence.

Sketch 5 shows gas manifolding used to support the burner. If there are multiple inlets, you must avoid rigid connection by using the oversize U-bolt (loosely drawn up) illustrated.

Support for down-fired burners can be accomplished as shown in the illustration at right. Always avoid rigid mounting.



Sketch 6 shows Maxon USB support brackets suspending the burner from an overhead angle iron.

Sketch 7 shows an alternate arrangement which offers the advantage of more controlled positioning.

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Installation Instructions (cont'd.)

Gas Train

See piping layout below to identify various typical system components.

Pipe size of gas line must be large enough to assure ample fuel pressure at maximum system capacity. Burner capacity is totally dependent on fuel differential being maintained. (See capacity/specification data for the actual fuel pressure required at the burner to achieve its rated capacity.)

Clean fuel lines are essential to prevent blockage of pipe train components or burner gas ports. All dirt, scale and pipe dope should be blown out of any gas line before actually connecting to the burner system.

Main shut-off cock should be upstream of both system regulator and pilot line take-off. Use it to shut off fuel to both pilot and main burner during extended shutdown periods. Maxon Control Valves are not intended for tight shutoff. Main system shut-off should always be accomplished with a manual fuel cock.

Main gas regulator is essential to maintain a uniform system supply pressure. A separate regulator should be provided in the branch leading to each burner system if more than one is served by a common main. Size regulator for full system capacity at required pressure, including pipe train losses.

The gas train piping illustrated should be installed as close to the burner as possible.

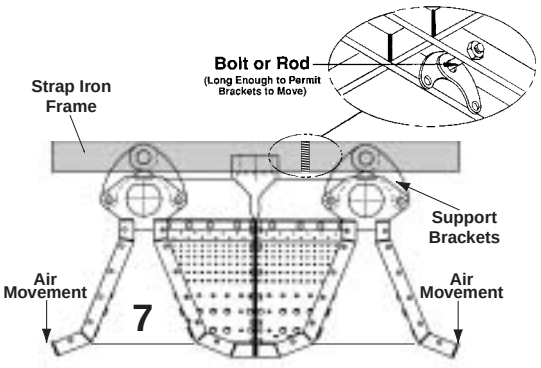
Pilot take-off should be upsteam of main gas regulator, but downstream of main gas cock. It normally includes pilot shut-off cock, pilot gas regulator and pilot solenoid valves. For pilot adjustment, a fixed orifice, or adjustable orifice is recommended at or near the pilot gas inlet.

Fuel shut-off valves, when properly wired to a safety control system, shuts the fuel supply off when a hazardous operating condition is sensed by your control circuit. Manual reset valves require operator attendence each time the system is started up (or restarted after a trip-out). Motorized shut-off valves permit automatic start/restart when used with appropriate control system.

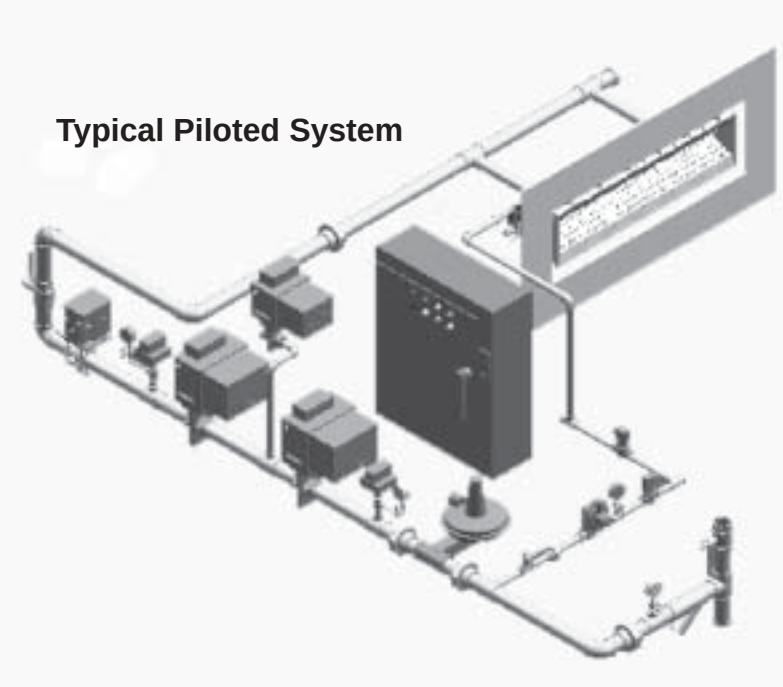
Fuel control valve controls burner heat release by throttling gas flow to it. It should include provision for an adjustable minimum and throttling over a turndown range that matches burner capabilities. The illustration shows a Series "CV" Flow Control Valve; but adjustable gradient SYNCHRO® and/or "Q" Flow Control Valves may be used.

Gas pressure test connections are provided in most Series NP-LE Burner end plate sets, but it is also helpful to provide an additional test connection in the piping between main gas regulator and fuel control valve. All connections must be plugged unless an actual pressure measuring device (gauge or manometer) is being used.

Maxon assumes no responsibility for the use or misuse of the piping layouts shown. Specific piping and wiring diagrams should always be submitted to the appropriate agencies for approval on each application.



Typical Piloted System



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Start-Up Instructions

Read complete instructions before proceeding, and familiarize yourself with **all** the system's equipment components. Verify that your equipment has been installed in accordance with the original manufacturer's current instructions.

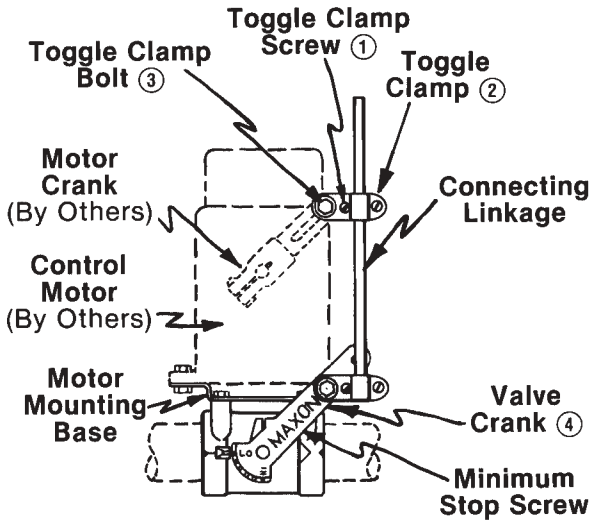
CAUTION: Initial adjustment and light-off should be undertaken only by trained and experienced personnel familiar with combustion systems, with control/safety circuitry and with knowledge of the overall installation. Instructions provided by the company and/or individuals responsible for the manufacture and/or overall installation of complete system incorporating Maxon burners take precedence over these provided by Maxon. If Maxon instructions conflict with any codes or regulations, contact Maxon Corporation before attempting start-up.

For initial system start-up:

1. Close all burner fuel valves and/or cocks. Make preliminary adjustments to fuel regulators.
2. Check all electric circuitry. Verify that all safety devices and interlocks are operable and functioning within their respective settings/ranges. Be sure all manifolds are tight and that test ports are plugged if not being used.
3. Check that all duct and chamber dampers are properly positioned and locked into operating positions.
4. Start main volume air fan. Check for proper motor rotation and impeller direction. Verify all safety interlocks are working. Allow air handling equipment to run adequate purge of manifold and combustion chamber plenums. Verify air volume and velocity across burner element to be within burner operating specifications.

CAUTION: Do not by-pass control panel timers typically controlling sequential operations.

5. Disconnect the automatic control motor linkage from your Maxon Control Valve by loosening the control motor's connecting rod from the valve's toggle linkage. Initial start-up adjustment should only be accomplished during a "manual" control mode. Manually set and secure control valve in its "minimum" position.



Typical Control Motor

6. To light and adjust gas pilot: Pilot gas regulator should initially be set at 2-5" wc. With pilot gas solenoid valves closed, open main fuel gas and pilot gas cock. Energize spark ignitor and open pilot gas solenoid. Turn adjustable orifice screw out (counter-clockwise) several turns from its fully seated position or adjust regulator pressure when fixed orifice is used. Observe pilot ignition through a sight port and/or by viewing micro-amp signal metered from flame safeguard relay circuit. Refine pilot setting for a hard blue flame (and/or strongest micro-amp signal) by adjusting gas flow through pilot orifice and/or pilot regulator.
7. Prepare to ignite main burner by adjusting main gas regulator to approximately midpoint of its adjustment range. Linkage arrangement for the use of Series "CV" Gas Control Valve is illustrated above for a typical control motor. Arrange accordingly.
8. With control valve at "minimum," ignite main burner by opening main fuel shut-off valves. Adjust main gas regulator to give the desired outlet pressure. Refine pilot adjustment if it has been affected. Adjust burner "minimum" by turning in on the minimum stop screw of the gas control valve until stable flame appears in the narrow zipper channel at the base of burner mixing plates.

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MAXON CORPORATION
MUNCIE, INDIANA, USA

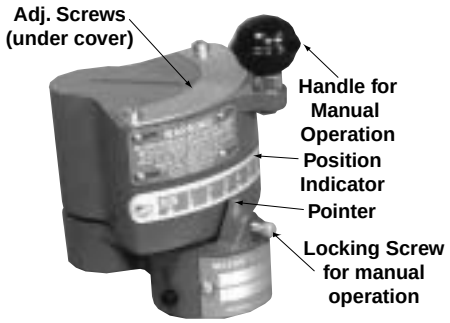
INDUSTRIAL COMBUSTION EQUIPMENT AND VALVES

Start-Up Instructions (cont'd.)

A good minimum fire should provide uniform flame across the entire burner face, contained within the zipper flame channel at the base of burner mixing plates. Any thin spots or gaps indicate uneven air velocity over the burner which must be corrected or a higher minimum fire established by continuing to turn in on the minimum stop screw. (See drawing on page 5550-S-2.)

NOTE: If your Maxon NP-LE AIRFLO® Burner was furnished with an adjustable gradient type **Series "Q" or SYNCHRO® Control Valve instead of a Series "CV" Valve, refer to step 8A through 8I** for specific instructions and differences in adjustment procedures.

For Series "CV" Valves, skip to step 9.



A. From step #5, the automatic control motor linkage has already been disconnected from your adjustable gradient type control valve and the valve is at its "minimum" position.

B. Open fuel supply and begin adjustment of appropriate adjustable gradient valve by turning in minimum (or lowest numbered) screw until desired flame is achieved. (Main fuel regulator may need adjusted at this point.)

C. Once your flame is established and refined at this position, and without advancing the screw carrier quadrant higher, screw all remaining screws down to at least the same level as your first adjusted screw.
NOTE: A preliminary setting can be established with all the remaining adjusting screws. Generally, each succeeding screw needs to be screwed in approximately one full turn deeper than its preceeding screw. A smooth "stair-step" gradient pre-set at this point from low to high will simplify the remaining adjustment steps.

D. Without advancing the SYNCHRO® Valve quadrant, screw down on #2 screw (one or two turns). Then slowly advance the SYNCHRO® Valve quadrant to the #2 position. Refine flame appearance at this new position #2.

E. Turn all higher-numbered screws in at least as far as the one just adjusted, then turn next one in as necessary to achieve desired flame while rotating valve mechanism to that position on indicator strip.

F. Repeat for each remaining screw.
NOTE: To avoid possible damage to cam strips, always turn all higher-numbered screws in as far as the last one adjusted.

G. Refine adjustment as needed, always turning valve so that position indicator matches screw being adjusted.
For more fuel, turn screw in (clockwise). for less fuel, turn screw out (counter-clockwise). If screws must be turned in flush with carrier casting, increase fuel pressure and readjust by starting at minimum over again.

H. Cycle system off and on, and through all firing rates until satisfied with performance.

I. Reconnect control motor linkage and check that operator does not "bind" and that all interlocks are performing properly.

9. Adjust burner "high fire" by slowly rotating fuel control valve crank arm towards its maximum. Observe flame characteristics carefully. Flame should remain a bright blue color with a length beyond the mixing plates as indicated in capacity/specification data. If flame becomes long and yellow, gas pressure is too high and/or air velocity is too low.
NOTE: Dust and/or chemicals entrained into passing air stream may effect physical color of flame. In this case, adjust burner for stable flame shape and geometry.
To measure gas pressure, connect water column (manometer) to the test connection in burner's end plate. To determine air velocity, use a velometer at the profile opening. Correct velocities by increasing or decreasing profile opening size.
If flame is too short, gas pressure may be too low and should be increased or velocities are too high and may need to be decreased. **Note that air velocities should be measured only when the fan is handling air at the desired control temperature.**

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Start-Up Instructions (cont'd.)

The desired maximum capacity may be achieved with less than full control valve opening. Mark with a pencil or scribe the point on valve crank arm where the desired maximum is obtained, then return crank arm to low position and shut system off.

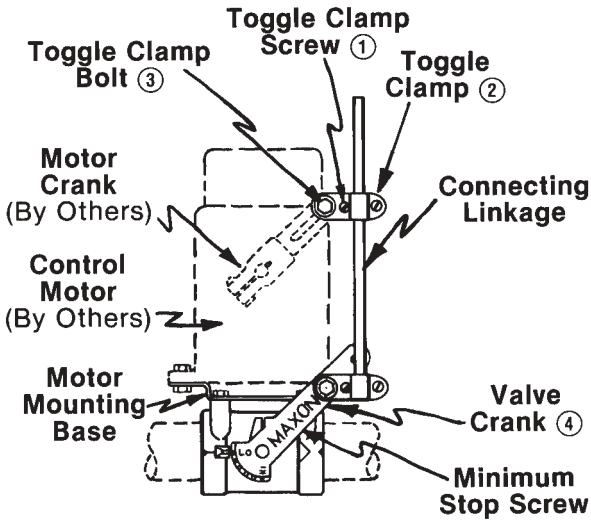
10. **If using Maxon Series "CV" Valve**, reconnect control motor linkage (with control motor in low or minimum position) by loosening toggle clamp screw **1** and moving toggle clamp **2** along the connecting linkage to a point where toggle clamp bolt **3** can be placed at the outermost position of control motor crank slot. Then tighten toggle clamp screw **1**, thus fixing clamp to linkage.

Allowing toggle clamp bolt **3** to slide in the crank arm slot, cycle control motor towards its maximum position and move fuel control valve crank **4** to the previously-determined maximum firing rate position. Tighten toggle clamp bolt **3**, thus fixing clamp to motor crank.

Cycle control motor back to minimum, watching carefully that it does not bind before reaching minimum.

If it is stopped or if minimum is not reached, loosen toggle clamp screw **1** and move toggle clamp along the connecting linkage so both motor and valve can assume their minimum positions. Then retighten toggle clamp screw **1**.

Refine adjustment by cycling several times between low and high control motor position while readjusting toggle clamp bolt **3** as necessary until control motor travels through its full cycle while moving control valve crank arm from its minimum only up to the desired maximum previously determined.



Typical Control Motor

11. Relight burner and cycle control system from low to high fire several times to observe performance. Refine adjustments of pilot and main burner minimum if necessary.

Warning: Test every UV Flame Sensor System for dangerous spark excitation from ignitors and other burners, as well as other possible sources of direct or reflected UV radiation.

12. Check carefully that all interlocks and limits are in full operating condition. Before system is placed into full service, instruct operator personnel on proper start-up, operation and shut-down of system. Establish written instructions for reference.

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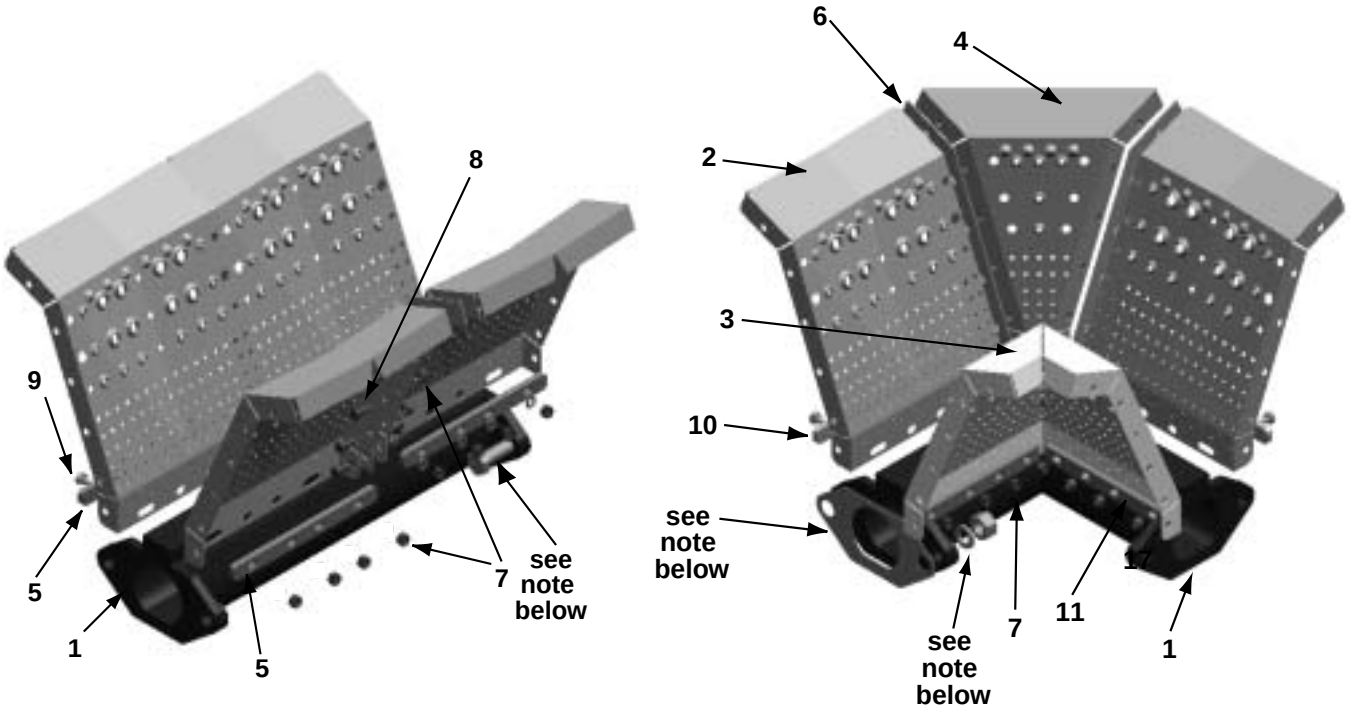
Maintenance and Component Identification/Spare Parts
NP-1-LE



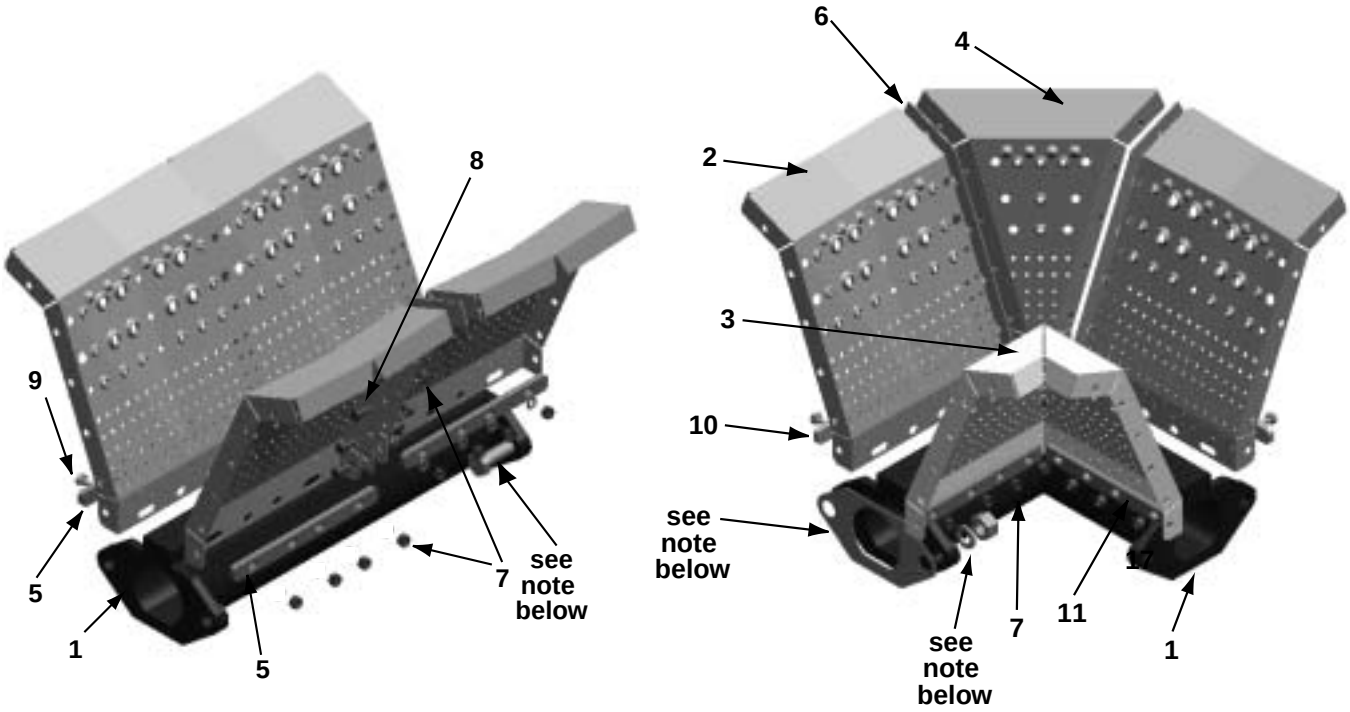
To order replacement parts:

1. See burner nameplate and indicate burner type.
2. Sketch burner arrangement (as viewed from casting side).
3. Specify replacement items required from diagrams above.
4. Specify quantity of each and assembly numbers from table below:

Item No.	Quantity Required for Indicated Section								Part Description	
1	6" Str. 1050373	12" Str. 1050376	18" Str. 1050373 + 1050376	24" Str. 1050376	12" x 6" Tee 1050387	6" x 6" Elbow 1050389	12" B.I. 1050385	36" B.I. 1050390	Asby. No.	Burner Body
2	2	4	6	8	2	2	4	4	1049073	Mixing Plate
3					2	1		4	1052004	Mixing Plate: Inside Corner
4						1			1049075	Mixing Plate: Wedge
5	2	4	6	8			4		18049	Back Up Bar
6	2	2	2	4	1	2	2	4	1049071	Gasket/Shim (Metal)
7	4	20	24	48	18	20	20	48	1051567	M5 K-Nut Plated
8		12	12	24	6	12	12	24	1051583	M5 x 10 ISO 4017 Plated Hex Bolt
9	4	8	12	16	12	8	8	24	1051570	M5 x 45 ISO 4017 Plated Hex Bolt
10					2	2		4	1050679	Outside Corner Back Up Bar
11					4	2		8	1050672	Inside Corner Back Up Bar

NOTE: These items included with fastener kits. See pages 5567 & 5568 for fastener kit details.

Maintenance and Component Identification/Spare Parts
NP-1-LE-AL



To order replacement parts:

1. See burner nameplate and indicate burner type.
2. Sketch burner arrangement (as viewed from casting side).
3. Specify replacement items required from diagrams above.
4. Specify quantity of each and assembly numbers from table below:

Item No.	Quantity Required for Indicated Section						Part Description	
1	6" Str. 1050375	12" Str. 1050384	12" x 6" Tee 1050388	6" x 6" Elbow ---	12" B.I. 1050386	36" B.I. 1050391	Asby. No.	Burner Body
2	2	4	2		4	4	1049073	Mixing Plate
3			2			4	1052004	Mixing Plate: Inside Corner
4							1049075	Mixing Plate: Wedge
5	2	4			4		18049	Back Up Bar
6	2	2	1		2	4	1049071	Gasket/Shim (Metal)
7	4	20	18		20	48	1051567	M5 K-Nut Plated
8		12	6		12	24	1051583	M5 x 10 ISO 4017 Plated Hex Bolt
9	4	8	12		8	24	1051570	M5 x 45 ISO 4017 Plated Hex Bolt
10			2			4	1050679	Outside Corner Back Up Bar
11			4			8	1050672	Inside Corner Back Up Bar

NOTE: These items included with fastener kits. See pages 5567 & 5568 for fastener kit details.

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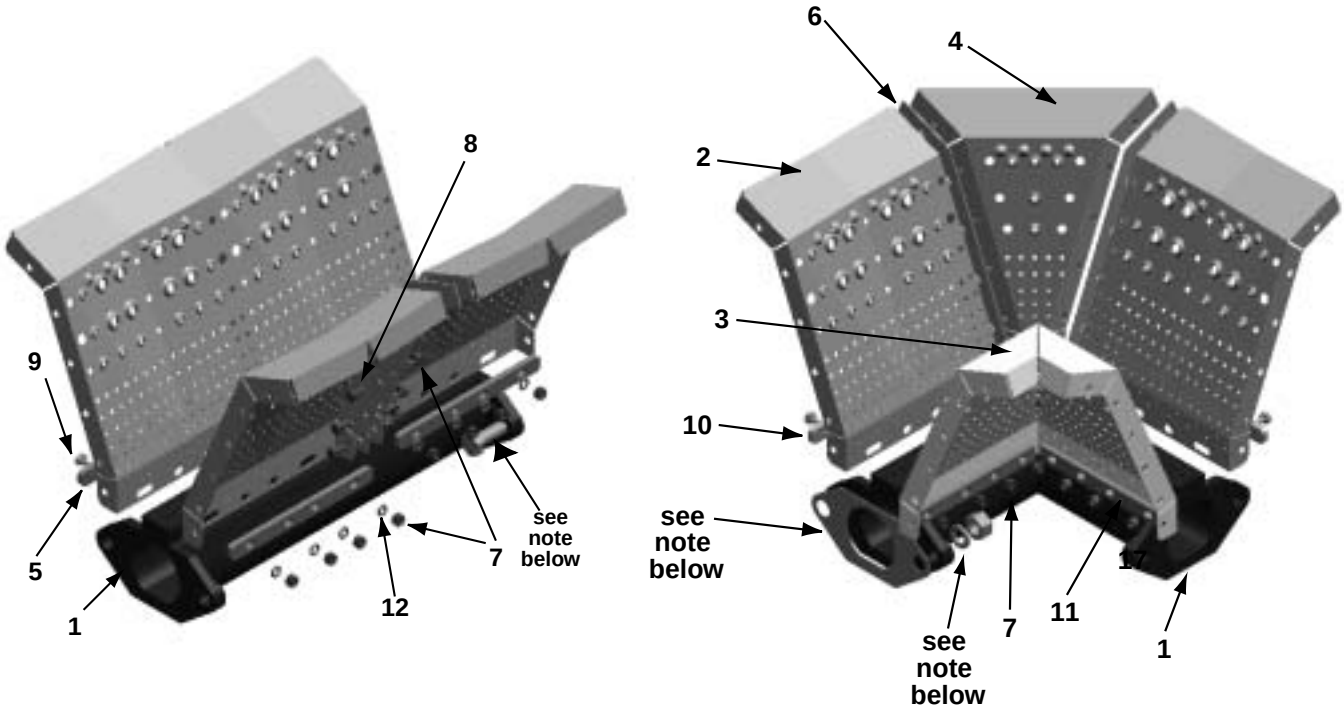
Maintenance and Component Identification/Spare Parts
NP-1-LE-AL-SS



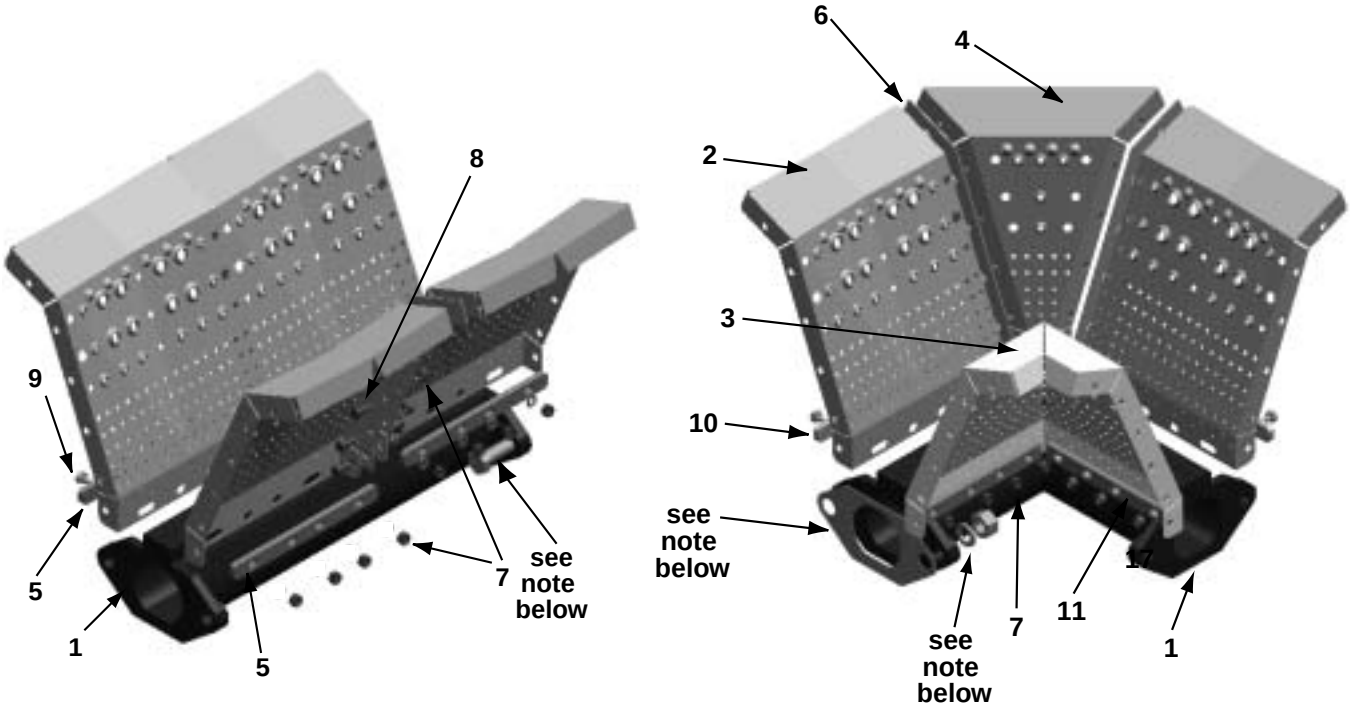
To order replacement parts:

1. See burner nameplate and indicate burner type.
2. Sketch burner arrangement (as viewed from casting side).
3. Specify replacement items required from diagrams above.
4. Specify quantity of each and assembly numbers from table below:

Item No.	Quantity Required for Indicated Section						Part Description	
1	6" Str. 1050375	12" Str. 1050384	12" x 6" Tee 1050388	6" x 6" Elbow 1050389	12" B.I. 1050386	36" B.I. 1050391	Asby. No.	Burner Body
2	2	4	2		4	4	1049073	Mixing Plate
3			2			4	1052004	Mixing Plate: Inside Corner
4							1049075	Mixing Plate: Wedge
5	2	4			4		45613	Back Up Bar (Aluminum)
6	2	2	1		2	4	1049071	Gasket/Shim (Metal)
7	4	20	18		20	48	1051566	M5 Nut Stainless Steel
8		12	6		12	24	54619	M5 x 10 ISO 4017 Hex Head Screw (Stainless Steel)
9	4	8	12		8	24	1051569	M5 x 45 Hex Head Screw Class A (Stainless Steel)
10			2			4	1050680	Outside Corner Back Up Bar (Aluminum)
11			4			8	1050673	Inside Corner Back Up Bar (Aluminum)
12	4	20	18		20	48	1051853	M5 Stainless Steel Lockwasher

NOTE: These items included with fastener kits. See pages 5567 & 5568 for fastener kit details.

Maintenance and Component Identification/Spare Parts
NP-2-LE



To order replacement parts:

1. See burner nameplate and indicate burner type.
2. Sketch burner arrangement (as viewed from casting side).
3. Specify replacement items required from diagrams above.
4. Specify quantity of each and assembly numbers from table below:

Item No.	Quantity Required for Indicated Section								Part Description	
1	6" Str. 1051634	12" Str. 1051636	18" Str. 1051634 + 1051636	24" Str. 1051636 (qty. 2)	12" x 6" Tee 1051640	6" x 6" Elbow 1051644	12" B.I. 1051638	36" B.I. 1051642	Asby. No.	Burner Body
2	2	4	6	8	2	2	4	4	1049073	Mixing Plate
3					2	1		4	1052004	Mixing Plate: Inside Corner
4						1			1049075	Mixing Plate: Wedge
5	2	4	6	8			4		18049	Back Up Bar
6	2	2	2	4	1	2	2	4	1049071	Gasket/Shim (Metal)
7	4	20	24	40	18	20	20	48	1051567	M5 K-Nut Plated
8		12	12	24	6	12	12	24	1051583	M5 x 10 ISO 4017 Plated Hex Bolt
9	4	8	12	16	12	8	8	24	1051570	M5 x 45 ISO 4017 Plated Hex Bolt
10					2	2		4	1050679	Outside Corner Back Up Bar
11					4	2		8	1050672	Inside Corner Back Up Bar

NOTE: These items included with fastener kits. See pages 5567 & 5568 for fastener kit details.

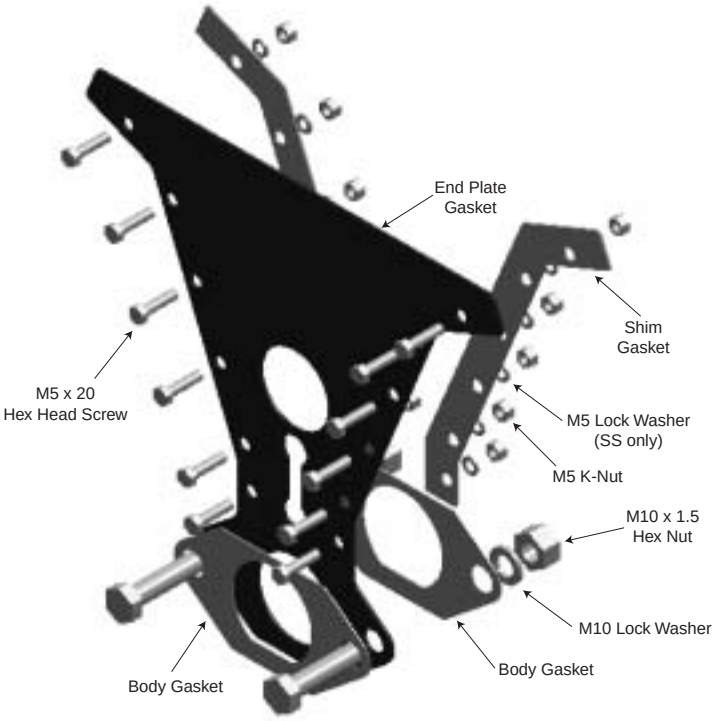
Maxon practices a policy of continuous product improvement. It reserves the right to alter specifications without prior notice.

MAXON CORPORATION
MUNCIE, INDIANA, USA

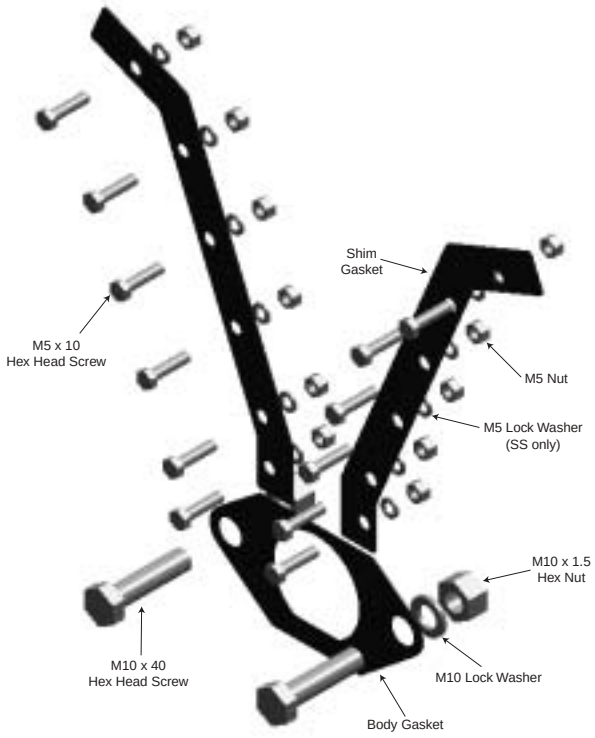
INDUSTRIAL COMBUSTION EQUIPMENT AND VALVES

Maintenance and Component Identification/Spare Parts Fastener Kits

End Plate Fastener Kit



Body to Body Fastener Kit



Replacement Items	Assembly Numbers			
	NP1LE	NP1LEAL	NP1LEALSS	NP2LE
Flange to Flange Fastener Kit (includes gaskets)	1051879	1051879	1051880	1051879
End Plate to Flange Fastener Kit (includes gaskets)	1051881	1051881	1051882	1051881
Body Gasket	1050424	1050424	1050424	1050424
Metal Shim Gasket	1049071	1049071	1049071	1049071
Metal End Plate Gasket	1050423	1050423	1050423	1050423
LT Plain End Plate to Flange Gasket Kit	1057896	1057896	N/A	1057896
LT Pilot End Plate to Flange Gasket Kit	1057893	1057893	N/A	1057893
LT - Metal End Plate Gasket - Pilot	1056603	1056603	N/A	1056603
LT - Metal End Plate Gasket - Plain	1056604	1056604	N/A	1056604

Maintenance Instructions

Periodic maintenance will insure continued trouble-free operation of your Series NP-LE AIRFLO® Burner system.

At least a yearly inspection is recommended for make-up air heating installations and more frequently for process applications in year-round operation. Your own experience is the best guide in determining frequency of inspection. As a minimum, the following procedure should be followed:

1. Shut the system down totally. Disconnect or lock out power supply so there can be no accidental start-up during inspection.
2. Inspect the burners carefully, including upstream and downstream sides of mixing plates as well as burner body face. Any accumulation of scale or foreign material on either side of the mixing plates should be removed with a wire brush. Check visually that no holes in the mixing plates are blocked. See next page (5550-S-12) for inspection and maintenance instructions for gas ports.

WARNING: Do not enlarge burner ports or performance may be drastically affected.

If any mixing plates are loose or missing fasteners, tighten/replace as necessary. Always use zinc plated or stainless metric fasteners.

3. Put system back into operation and, if possible, view from downstream side while cycling burner through full firing range. This will give a visual check for blocked burner ports.
4. Observe flame pattern and, if necessary, take steps to correct velocity and/ or air distribution problems.

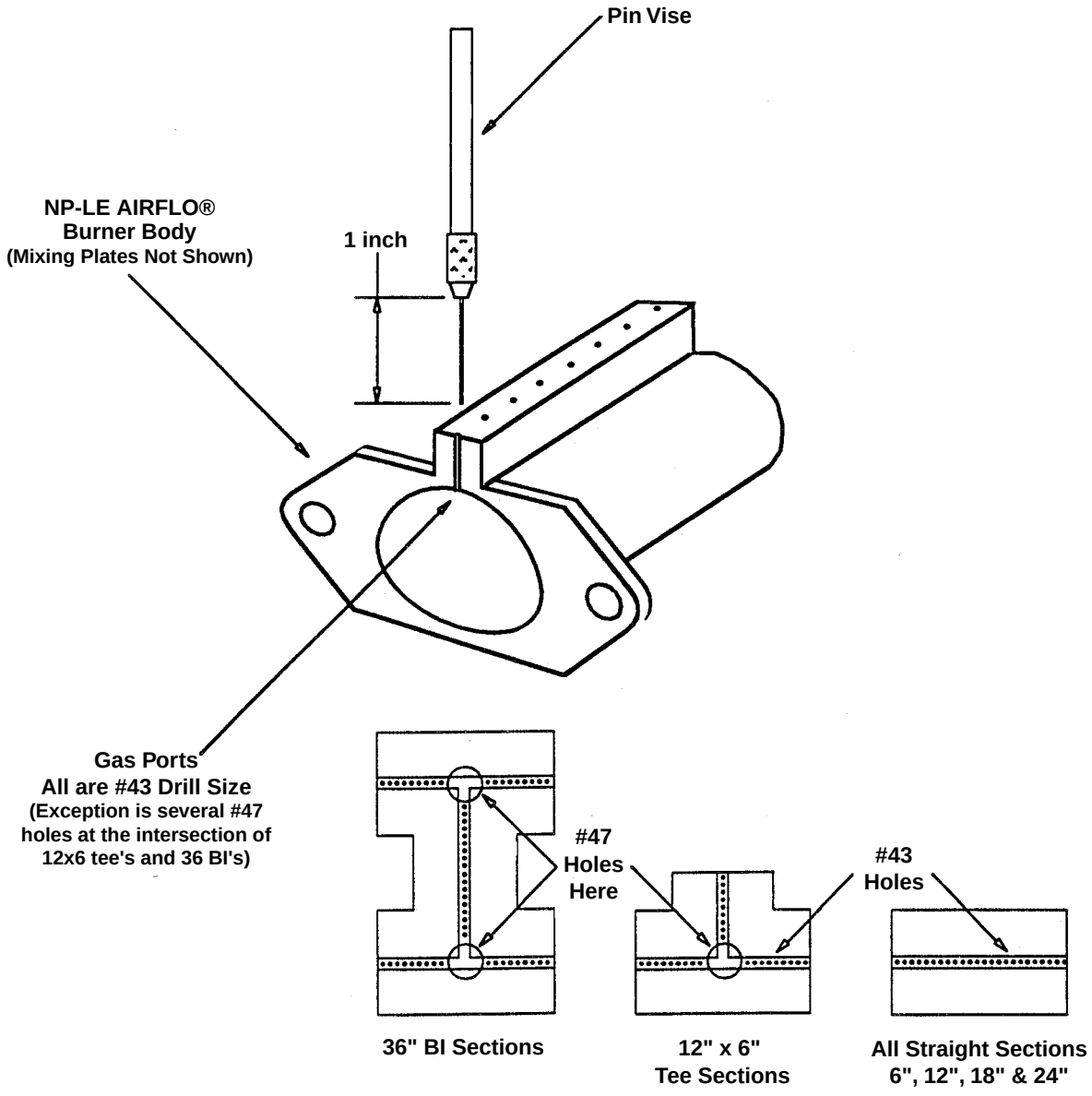
Repair / Replacement Procedures

If adverse operating conditions or accidental damage make it necessary to replace either individual mixing plates or complete burner sections, follow this procedure:

1. Identify necessary replacement parts from component identification drawings on preceding pages, then order required quantities of each. Consider carefully the economics of installing a complete replacement burner instead of replacing individual parts. Once exposed to actual flame temperatures, burner castings harden and the removal and replacing of fasteners can be time consuming and difficult. Accessibility may also be severely limited requiring removal of complete assembly in any case.
2. When necessary parts have been received, remove damaged mixing plates or burner sections, taking care not to damage remaining portion of burner. If new burner bodies are being installed, place body gasket on the mating flanges of loose cast iron bodies. (This is necessary to provide a gas-tight seal after assembly.) Insert new section into place, making sure that both flanges are square and flush, then bolt sections together.
3. Install new mixing plates, back up bars and plate support brackets to the new body castings.
4. If end plate sets must be installed, put in position between mixing plates and insert fasteners loosely. Do not tighten at this time.
5. Tighten burner body bolts making sure that mating cast iron flanges remain square and flush.
6. Align mixing plates and check that body gaskets are in position and properly aligned. Tighten all mixing plate mounting screws and bolts.
7. Double check that all fasteners are secure.
8. Return burner to operation, observing flame carefully at all firing rates.

Inspection and Maintenance of Gas Ports

– Conduct initial inspection within the first month after commissioning. Visually check the gas ports of new burner assemblies for any piping scale or debris. Use Pin Vise with drill bit to remove.
– Annual inspections are normally adequate once the initial piping debris is removed. The operating conditions of the burner will determine how frequently maintenance is actually required.
– Use of an electric drill motor is not suggested unless both Pin Vise and Drill (as shown below) can be chucked up in a vari-speed drill unit. Use caution, because it is easy to snap the bits off in a port when using a drill motor. Removal of broken bits from the gas ports is difficult.
– Contact your Maxon representative to answer questions or address any problems.



III

COMPONENT MANUALS GAS CONTROL VALVE

Flow Control Valves

3" Series "Q" Valve

Series "Q" Gas Control Valves provide the high capacity and low pressure drop benefits of a butterfly valve construction, plus an adjustable gradient feature for accurate fuel flow control.

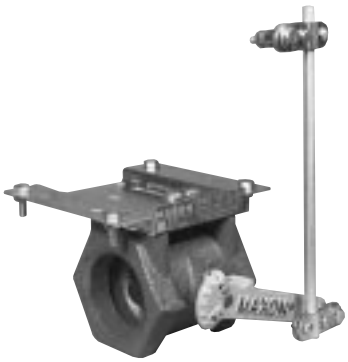
They are used independently for throttling of fuel gases and with PREMIX® Blower Mixers and AIRFLO® Mixers for stand-by fuel systems, where they allow change-over to alternate fuels without re-adjustment.

Series "Q" Valves are UL (Underwriters Laboratories) listed for use with air, natural gas and liquefied petroleum gases.

Series "CV" Control Valves incorporate a full-flow, fixed gradient butterfly valve design for high capacities at low pressure drops, using minimum operating torque.

This economical assembly includes a minimum stop screw and can be supplied with connecting base and linkage assembly to mount your electric control operator.

Versions available with UL (Underwriters Laboratories) listing for air, natural gas and liquefied petroleum gas service.



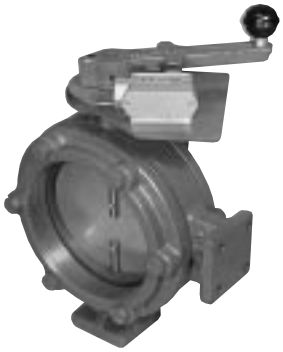
2" Series "CV" Valve with optional connecting base and linkage assembly

Series "BV" Balancing Valves are used to balance gas or air flows in multiple-burner systems fed by a common manifold. They feature a full-flow butterfly design with provision for locking in any position.

2-1/2" Series "BV" Valve

Air Control Valves permit throttling control of air to burners. They feature a fixed gradient butterfly valve design with an adjustable minimum stop, friction brake screw and provision for manual or automatic operation. Air control valves are offered in 1-1/2" through 18" pipe sizes.

A complete system using Maxon Flow Control Valves will typically include burner, gas and/or oil pipe trains, mixing equipment, pressure blower and a control panel. Your Maxon representative can help you choose from the broad range available.



M-6" Manual Air Control Valve with optional Low Fire Start Switch

Installation Instructions

– **Support weight of piping independently.** Do not place any Maxon Flow Control Valve in a piping bind. Provide pipe hangers and/or special support for related manifolds.
– **Maxon connecting base and linkage assemblies are designed to locate and/or position the control operator** for its interaction with the Flow Control Valve assembly. They are not intended to support the weight of the control motor. Special provisions will be required to support the weight of the control operators.
– **Use of pipe heavier than schedule #40 can cause interference** with butterfly-type Flow Control Valves and restrict the valve from full opening.
– **Flow Control Valves provide the means to adjust fluid and/or gas flows.** They should be installed with at least four pipe diameter lengths of straight pipe before and after the valve. This lessens the chance of internal flow turbulence being set-up in the piping manifolds and control valve.
– **Check fluid flow direction through "-P" and "-O" poppet-type valves.** It must flow only in direction matching the arrow cast into valve body. If necessary, valve body may be rotated per instructions given on page 7016.
– **Install flow control valves carefully and maintain adequate dimensional clearance** to allow full stroke and travel of the valve's control linkage. Internal drive mechanisms within a control motor may be damaged if linkage is restricted as to cause binding in high or low flow position.

CAUTION: All Flow Control Valves are designed for throttling service only and are not intended for tight shut-off.

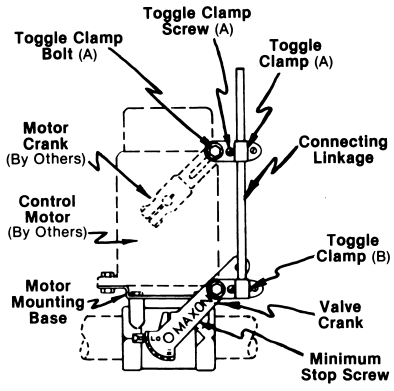
– **Main system shut-off should always use a manual "leak-tight" upstream fuel cock.**

Mounting Instructions for motor operator on Series "CV" Flow Control Valves

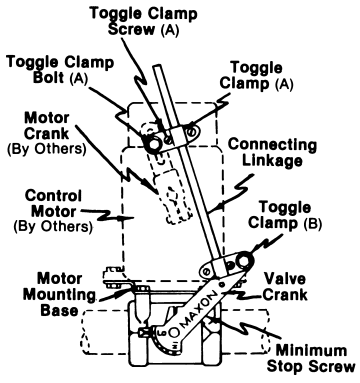
For those Series "CV" Valve assemblies furnished with connecting base and linkage, the accompanying diagrams illustrate mounting procedures relative to each specific type operator.

First, mount your control motor to connecting base in accordance with diagrams at right.

Secondly, determine if your electric operator travels through 90° or 180° rotations. Then arrange connecting linkage and motor crank arm as shown below for your specific operator.



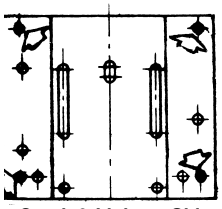
90° Control Motor



160° – 180° Control Motor

Honeywell #M644, M744, M941 or M944
(7616BR Crank)

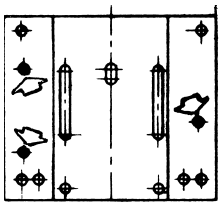
Mount with four short bolts and nuts at indicated holes.



Crank & Linkage Side

Barber-Colman EA50

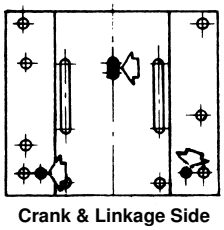
Mount with three short bolts and nuts at indicated holes.



Crank & Linkage Side

Penn/Johnson M80, M81
(MD3-600 Crank)

Mount with two short bolts and nuts and long bolt screwed into operator base through slotted hole.



Crank & Linkage Side

Adjusting Instructions

Notice: *Only generalized instructions can be provided here. Detailed adjusting instructions are provided with each individual Maxon burner and/or mixer system.*

General Instructions

Important: Do not discard packing materials until all loose items are accounted for.

To prevent damage in transit, some connecting base and linkage components may be packed separately and shipped loose with your new Maxon Flow Control Valve.

The Flow Control Valve is normally only a part of your complete combustion system. Additional pipe train accessories and control components may be required for a complete system installation.

Read complete instructions before proceeding, and familiarize yourself with all the system's equipment components. Verify that your equipment has been installed in accordance with the original manufacturer's current instructions.

CAUTION: Initial adjustment and light-off of burner systems should be undertaken only by trained and experienced personnel familiar with combustion systems, with control/safety circuitry, and with knowledge of the overall installation. Instructions provided by the company and/or individuals responsible for the manufacture and/or overall installation of complete system incorporating Maxon burners take precedence over these provided by Maxon. If Maxon instructions conflict with any codes or regulations, contact Maxon Corporation before attempting start-up.

For initial adjustment and/or burner start-up:

1. **Close all burner fuel valves and cocks.** Make preliminary adjustments to fuel gas regulators.
2. **Check all electric circuitry.** Verify that all control devices and interlocks are operable and functioning within their respective settings/ ranges. Be sure all air and fuel manifolds are tight and that test ports are plugged if not being used.
3. **Check that any air handling dampers are properly positioned** and locked into operating positions.
4. **Disconnect the automatic control motor's linkage** from your control valve's operating crank arm by loosening the control motor's connecting rod from the burner's toggle linkage.
   Initial adjustment should only be accomplished during a "manual" control mode.
5. **Start all system-related fans and blowers.** Check for proper motor rotation and impeller direction. Verify that all control interlocks are working. Allow air handling equipment to run for adequate purge of your manifolds.

CAUTION: Do not by-pass control panel timers typically controlling sequential operations.

6. **With MICRO-RATIO® Valve combinations of air and fuel valves, the minimum differential pressure setting is initially established with the air valve only.**
   A. By disconnecting the linkage between the air butterfly valve and interconnected fuel valve(s), the minimum and maximum limits of travel on the air valve may be determined. For example, a combustion system may need the air valve to be 15° open for the "minimum" setting and the "maximum" requirements are satisfied with the air valve open to 60°. By marking these points on the air valve's indicating strip, you are ready to reconnect the SYNCHRO Fuel Valve's linkage to the air valve.
   B. **The next step involves adjusting the connecting linkage** between the air valve and the fuel valve(s) so that each fuel valve travels its full quadrant range (i.e. from minimum to maximum), while the air valve swings from its pre-determined minimum and maximum positions.
   C. **With Series "CV" Valves and Series "Q" adjustable-gradient Flow Control Valves,** the minimum flow position is set by their minimum stop screw. This adjustable stop is located on the side of the screw carrier of Series "Q" Valves and at the base of crank arm of Series "CV" Valves. Screwing "in" on the minimum stop screw produces a physical stop on the quadrant's travel that prohibits valve from being completely closed off.

IV

COMPONENT MANUALS GAS SHUT-OFF VALVE

Normally open or normally closed valves

4" Series 5000-SCP position "L"

1.5" Series STO-M position "L"

4" Series 7000 position "L"

- **Sanctioned service valve approvals:**
  - FM (Factory Mutual) sanctioned
  - UL (Underwriters Laboratories) sanctioned
  - CGA (Canadian Gas Association) sanctioned
  - IRI (Industrial Risk Insurers) approvable for block/bleed/vent systems
  - Contact your Maxon sales representative for international sanctions information
- **Handles flowing fluid temperatures:**
  - Rising stem bodies from -20°F (-28°C) to +140°F (+60°C)
  - Swinging gate bodies from -20°F (-28°C) to +550°F (+288°C)
  - Any ambient temperature from -20°F (-28°C) to +140°F (+60°C)
- **Valve body connections designed to ANSI** (American National Standards Institute) standards. ISO (International Standards Organization) standards also available.
- **Various application requirements met** with manual reset or automatic reset motorized operators.
- **Minimize line pressure drops** with straight-through flow swinging gate or rising stem (guillotine action) valve bodies

Installation Instructions

1. **Read complete instructions** before proceeding and do not discard packing materials until any/all loose items are located. Also, make sure that the installation of the Maxon valves will be in compliance with all applicable governmental, insurance and/or agency requirements or codes, such as NFPA-70, National Electric Code, CSA C22.1, Canadian Electric Code, etc.
2. **General considerations:**
   - **A.** Prior to shipment, each valve is operated electrically and cycled at rated and 1-1/2 rated pressure while being leak tested. **Every Maxon valve is operationally tested and meets the requirements of ANSI B16.104 Class VI Seat Leakage when it leaves our plant.**
   - **B.** **Inspect your valve** for any shipping damage. Contact Maxon Corporation with the valve's serial number (printed on the valve's nameplate) for replacement and/or repair parts.
   - **C.** **Read the nameplate on your valve.** This gives the maximum pressure, temperature limitation, voltage requirements and service conditions of your specific valve. **DO NOT exceed nameplate ratings.**
   - **D.** **Select mounting location carefully.** Your Maxon valve is designed to operate for many years if installed in a location that is cool, clean and dry.
3. **Pipe the valve** in the direction of the flow arrow **[3]** on the valve body. The Maxon valve body can shut off flow in one direction only.
   - **A.** **Remove all thread and flange protectors** before installing valve in your service line.
   - **B.** **Teflon tape** acts as a lubricant and greatly reduces the pipe wrench turning force required to seal the threads.

     Take care not to overtighten threads as this can damage the valve.
   - **C.** **Good piping practice** dictates that piping be independently supported, so that valve bodies are not placed in a bind. In addition, large valves may require support.
   - **D.** **Clean pipe lines** of foreign materials before installing valve into line.

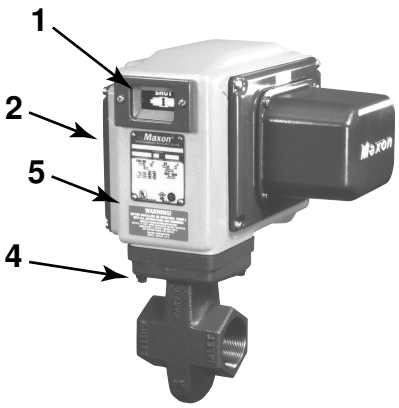
For new installations, a gas filter or strainer shall be installed in the fuel gas piping to protect the downstream safety shut-off valves.

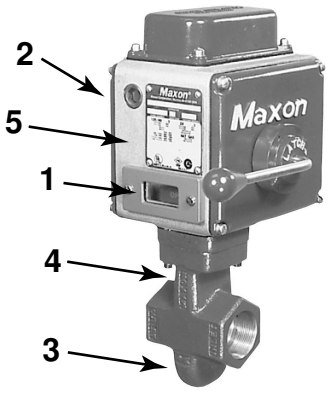
per NFPA 86-4-2.4.3 (1999)
NFPA 86C-4-2.4.3 (1999)
NFPA 86D-4-2.4-3 (1999)

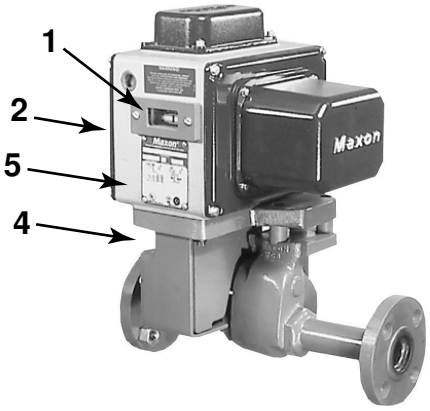
If normal inlet pressure to the fuel pressure regulator immediately upstream from the valve exceeds the valve's pressure rating, a relief valve shall be provided and it shall be vented to a safe location.

per NFPA 86-5-7.1.7 (1999)
NFPA 86C-5-7.1.7 (1999)
NFPA 86D-5-7.1.7 (1999)

   - **E.** **Mount valve** so that open/shut window indicator **[1]** will be visible to your operating personnel. **The open/shut window indicator should never face downward.** With Maxon electro-mechanical top assemblies, the motor access side plate **[2]** should always be vertical to the ground. Valves are usually installed in horizontal piping; however, other







Installation Instructions (cont'd.)

orientations are acceptable, subject to the above limitations. The top assemblies of all Maxon valves are field rotatable to allow installations involving conflicts with these mounting restrictions.

F. Main system shut-off should always use a manual leak-tight upstream fuel cock.

G. Time lag between valve action and fluid flow (or flame response) is reduced if valve is located near the burner (or outlet).

4. Wire the valve in accordance with **all** applicable codes and standards. Supply voltages must agree with valve's nameplate voltage within -15%/+10% AC or DC for proper operation. For electrical wiring schematics, refer to appropriate Maxon catalog literature and/or the wiring schematic diagram affixed inside your valve's access cover plate or in the terminal block cover housing.

A. The Maxon valve must be electrically interlocked with your safety-limit devices in accordance with all applicable codes, standards, and the authority having jurisdiction over the safety requirements for your overall system installation. Normally, Maxon valves are electrically wired in series with all of your safety-limit devices. Therefore, any one device can cause the valve to react. Each valve was production tested when manufactured. If it now appears inoperative, make sure it is being powered properly from and through your control circuit.

B. Maintain integrity of Maxon top assembly enclosure by using dust and water-tight electrical connectors. Use cable-sealing grips and strain-relief loops for any cord or cable. Use internal sealing materials on all conduit connections. Moisture can have a harmful effect on valve internals if permitted to enter through wiring connectors. Make sure that all access cover plates are in place and securely fastened. All cover screws should be tightened using an alternate cross corner tightening pattern to the values shown below.

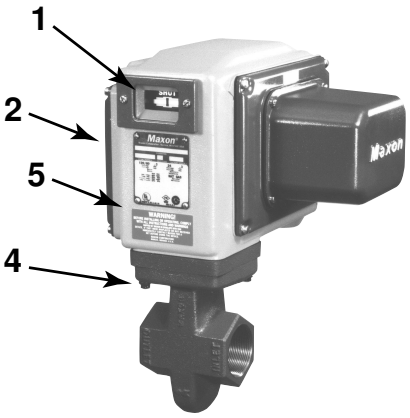
Cover	Torque (in-lbs)
#10-24 Operator Cover	25
.25"-20 All other access covers	50
.25"-20 Extended Access Cover Plate	96

While all covers are torqued at time of production testing, torque should be rechecked periodically to ensure adequate sealing protection.

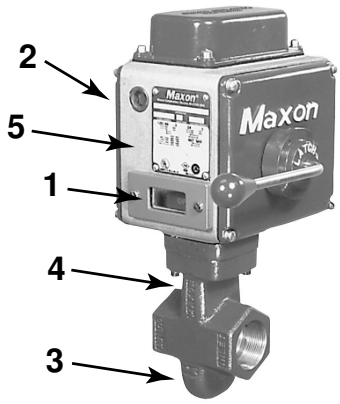
5. Pre-operational exercising:
Prior to initial fluid flow start-up and with upstream manual cock still closed, operate the valve electrically for 10-15 cycles. This not only provides an electrical check, but also wipes valve body disc and seat free of accumulated foreign matter.

Installation Instructions (cont'd.)

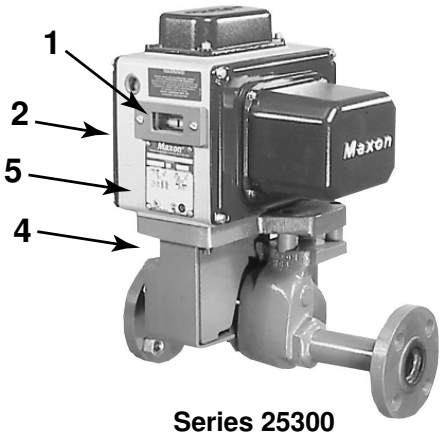
Top Assembly Rotation



Series 5000-CP



Series 808



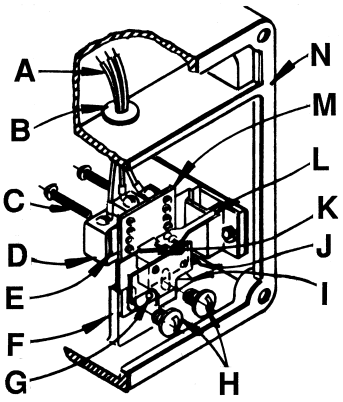
Series 25300 with socket welded nipples & flanges

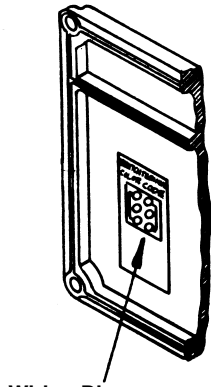
Maxon valves can and should be ordered in a configuration compatible with planned piping, but if open/shut indicator window is not visible and/or valve orientation is not proper, the top assembly can be rotated in 90° increments around the valve body centerline axis by the following procedure:

1. **Shut off all electrical power** and close off upstream manual cock.
2. **Remove wiring access cover plate [2]** and disconnect power lead wires. (Tag carefully for later re-assembly.)
3. **Remove conduit and** electrical leads.
4. **Note physical position** of any signal switch actuator wands on auxiliary signal switches (see switch arrangement sketch).
5. Unscrew the two body bolts [4] screwed up from the bottom to 1/4 inch. DO NOT completely remove. These bolts secure the valve body [3] to the valve's top assembly housing [5].
6. **Gently lift the top assembly** [5] **(not more than 1/4" in height)**; just enough to break the seal between the valve body assembly and the rubber gasket adhering to the bottom of the top housing.

WARNING: LIFTING TOO FAR MAY DISLODGE SOME SMALL PARTS INSIDE THE TOP HOUSING, REQUIRING COMPLEX RE-ASSEMBLY AND RETESTING BY TRAINED FACTORY PERSONNEL.

Auxiliary Switch Arrangement





Wiring Diagram

A– Number Coded Wires
B– Rubber Grommet
C– Mounting Screws
D– Normal (de-energized) Position Switch
E– Insulating Barrier
F– Bracket Mounting Pad
G– Drive Pin & Locating Hole
H– Mounting Screws
I – Spring Retainer Extension
J– Switch Wand
K– Actual (energized) Position Switch
L– Switch Wand
M–Switch Mounting Bracket
N– Gasket

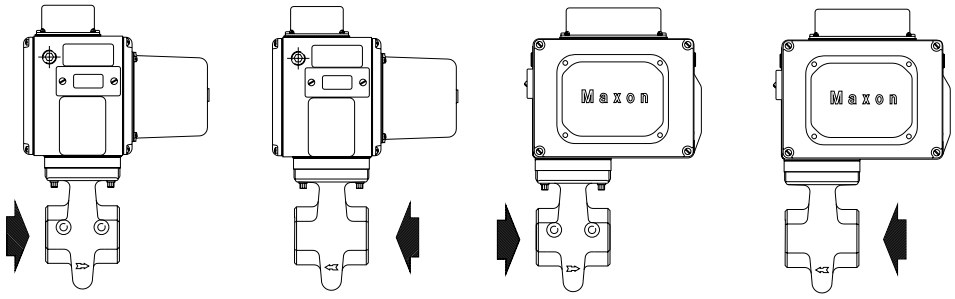
Installation Instructions (cont'd.)

Top Assembly Rotation (cont'd.)

7. **Remove the two body bolts [4] screwed up from the bottom (were partially unscrewed in step 5).**
8. **Carefully rotate top assembly** to the desired position in a plane parallel to the top of the valve body casting. **Rotate the top housing about 30° beyond this position, and then rotate it back.** Reposition the top housing back down onto the valve body casting. This should align the open/shut indicator with its window and provide proper alignment of the internal mechanism.
9. **Realign holes** in valve body casting with the corresponding tapped holes in the bottom of the top assembly housing. Be sure the gasket is still in place between the body and top housing.
10. **Reinsert the body bolts** up from the bottom through the body and carefully engage threads of the top assembly. Tighten securely.
11. **Reconnect conduit and electrical leads,** then check that signal switch wands are properly positioned and that open/shut indicator moves freely. **Failure to correct any such misalignment can result in extensive damage to the internal mechanism of your valve.**
12. **Energize valve and cycle several times** from closed to full open position. Also electrically trip the valve in a partially opened position to prove valve operates properly.
13. **Replace and secure side cover access plate** and place valve in service.

Cover	Torque
#10-24 Operator Cover	25 in/lbs
.25"-20 All other access covers	50 in/lbs
.25"-20 Extended Access Cover Plate	96 in/lbs
.31" Body Bolts	15 ft/lbs
.38" Body Bolts	40 tl/lbs

Alternate Top Assembly Positions



"R" "L" "AW" "TO"

Four top assembly positions are available for most Maxon valves. When looking at the open/shut window indicator of an electro-mechanical valve assembly, the motor (for motorized version), or the operating handle (for manual version), will be on the right side of the top assembly. The valve body is on the bottom. From this view, the unidirectional valve body and the arrow on the valve body casting points in direction of fluid flow: to the right (position "R"), to the left (position "L"), towards you (position "TO") or away from you (position "AW"). With smaller size swinging gate valve bodies, only position "R" and position "TO" may be used.

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Operating Instructions

Refer to appropriate catalog bulletin and specification page for operating sequence applying to your specific valve. **Never operate valve until all essential allied equipment is operative and any necessary purges completed.** Failure of electro-mechanically operated valve to operate normally indicates that it is **not** powered. **Check this first!** Then check internal holding solenoid and/or motor operator.

Main system shut-off should always be accomplished with an upstream leak-tight manual fuel cock.

All Maxon valves react within a fraction of a second when de-energized (can drop out if electrical power is interrupted for less than 1/2 cycle [8 ms]).

All electro-mechanical manual reset valves may be operated manually when solenoid is electrically energized, but electrical tripping is recommended for normal shut-downs.

Electro-mechanical manual reset valves require two positive actions to open: a half rotation of handle to latch internal mechanism, and a reversed half rotation of handle to open valve. This refers to normally closed valves. With normally open valves, the procedure is the same, but the valve body position (i.e., open or closed) is opposite to the normally closed version.

Remotely located manual reset valves may be equipped with wheel-and-chain assembly. Instructions to operate the valve are on hand grip. Locate counterweight overhead at pipe level and hand grip can be brought down to convenient operating personnel height.

Normally closed motorized valves begin opening cycle immediately upon being powered; motor runs only until full open position is reached. Normally open valves begin to close immediately, and motor runs until fully closed position is reached.

Operator should be aware of and observe characteristic opening/closing action of the valve. Should operation ever become sluggish, remove valve from service and contact Maxon for recommendations.

Address inquiries to: Maxon Corporation, P.O. Box 2068, Muncie, IN 47307
Phone (765) 284-3304
FAX (765) 286-8394
www.maxoncorp.com

Always include valve serial number and nameplate information to insure positive identification.

Maintenance Instructions

Maxon valves are endurance tested far in excess of the most stringent requirements of the various approval agencies. They are designed for long life even if frequently cycled, and to be as maintenance-free and trouble-free as possible.

Every Maxon valve is operationally tested and meets the requirements of ANSI B16.104 Class VI Seat Leakage when it leaves our plant.

Top assembly components require no field lubrication and should **never** be oiled.

Auxiliary switches, motors and solenoids, may be replaced in the field.

WARNING: Do not attempt field repair of valve body, top assembly or motor drive unit. Any alterations void all warranties.

Valve leak test, performed with valve in line as prescribed by jurisdictional authorities, is strongly encouraged and should be done on a regularly scheduled basis. In rare instances where valve shows leakage, perform **Pre-Operational Exercising** (see below) and retest. If leakage does not stop, remove valve from service.

Pre-operational exercising: Prior to initial fluid flow start-up and with upstream manual cock still closed, operate the valve electrically for 10-15 cycles. This not only provides an electrical check, but also wipes valve body disc and seat free of accumulated foreign matter.

Maxon valves are designed to be used with clean fluids. If foreign material is present in the fuel line, it will be necessary to inspect the valve to make certain it is operating properly. If abnormal opening or closing is observed, the valve should be removed from service. Contact your Maxon representative for instructions.

Insurance authorities agree . . .

. . . that the safety of any industrial fuel burning installation is dependent upon well-trained operators who are able to follow instructions and to react properly in cases of emergency. Their knowledge of, and training on, the specific installation are both vital to safe operation.

Safety controls may get out of order without the operator becoming aware of it unless shutdowns result. Production-minded operators have been known to bypass faulty controls without reporting the trouble.

Continued safe operation of any installation is then assured only if the plant management carefully develops an exact schedule for regular periodic inspection of all safety controls, insisting that it then be rigidly adhered to.

A main gas shut-off cock should be located upstream from all other fuel train piping components and used to shut off all flow of fuel for servicing and other shutdowns.

All safety devices should be tested at least monthly* and more often if deemed advisable. Periodic testing for tightness of manual or motorized shut-off valve closure is equally essential.

*per NFPA 86-Appendix B-4 (1995)

Operator should be aware of and observe characteristic opening/closing action of the valve. Should operation ever become sluggish, remove valve from service and contact Maxon for recommendations.

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Auxiliary Signal Switches

Field Installation Instructions

NOTE: Instructions below are written for normally closed valves. For normally open versions (STO-M, STO-A, Fig. 1 & 2), reverse switch nomenclature. (VOS becomes VCS and vice versa.)

General: Shut off fuel supply upstream of valve, then de-energize valve electrically.

– Remove top or side cover to provide access, being careful not to damage gasket.
– Compare with illustrations at right to identify YOUR valve type.

To replace existing switches:

– Note wand position and mounting hole location carefully, then remove 2 screws and lift existing switch.
– Install replacement switch in same mounting holes on bracket and verify correct wand position.
– Replace existing wiring one connection at a time, following original route and placement.

To add switches to existing valve:

– Check illustrations at right. If your valve uses a switch mounting bracket as in Fig. 1 & 2, mount switches to bracket using the mounting holes appropriate for valve type and size.
– Position bracket so VCS wand just touches top of actuator, then move downward slightly, depressing wand until switch clicks, then tighten mounting screws to hold this position.
– Pin bracket by drilling 1/8" dia. holes 1/4" deep into bracket mounting pad through drive pin holes, then tap drive pin in until flush.
– Route wires to wiring compartment as shown, then complete wiring connections and clean out metal drilling chips from previous procedure.
– Cycle valve, checking switch actuation points carefully. (VCS actuates at top of stem stroke, VOS at bottom.) Simultaneously the valve body must be tested for switch continuity and seat leakage. Bend VOS switch wands slightly if necessary to insure valve is opening fully.
– Replace gasket and cover, then return valve to service.

Cover	Torque (ft-lbs)
#10-24 Operator Cover	25
.25"-20 All other access covers	50
.25"-20 Extended Access Cover Plate	96

Fig. 1
.75" – 3" non-CP

Remove side cover plate. Switches mount on bracket. (See "A" below)

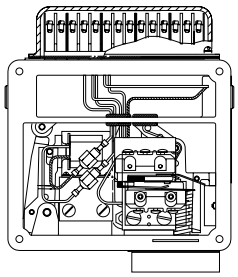


Fig. 2
2.5" – 4" -CP
6" 808

Remove side cover plate. Switches mount on bracket. (See "B" below)

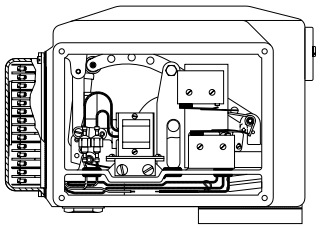


Fig. 3
4" – 6" 7000

Remove 2-piece top cover. Switches mount on support stand.

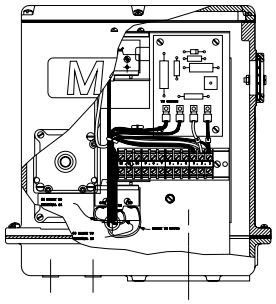
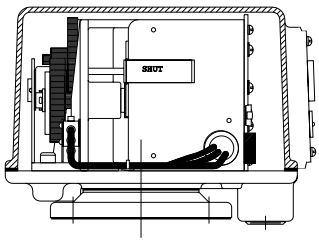


Fig. 4
.375" – .75" 8700

Remove top cover. Switches mount on actuator frame

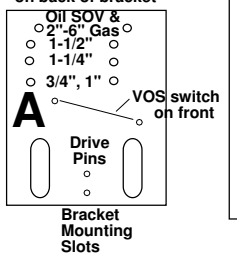


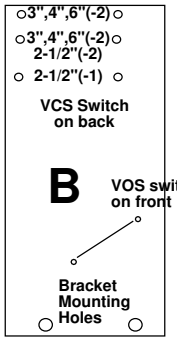
Wand Position Mounting Brackets

VOS switch wand should be actuated **from above.**

VCS switch wand should be actuated **from below.**

For 1", 1.25" C.I. & 2", 3" non-CP





Electrical Data

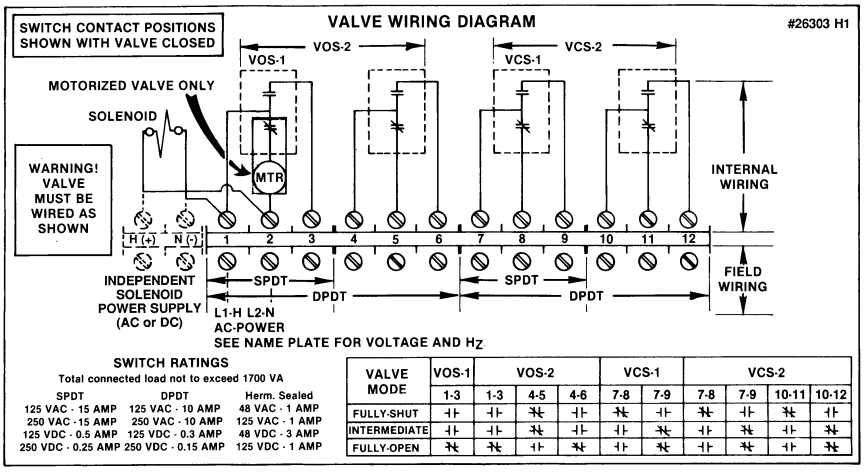
Normally Closed Valves

Manual Reset Series:

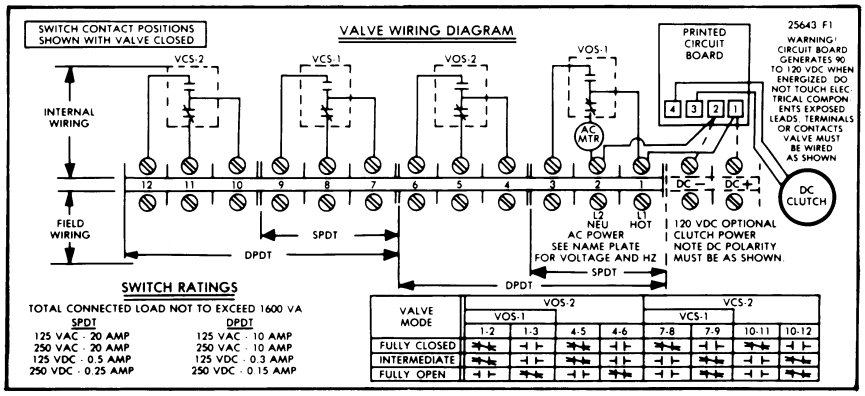
.375" – 3" Series 808, 818 (-S);
1" – 1.25" Series 730, 760, 790 (-S);
1" – 1.25" Series 33790 (-S):
2.5" – 4" Series 808-CP (-S); 818-CP (-S);
6" Series 808, 818 (-S)

Automatic Reset Series:

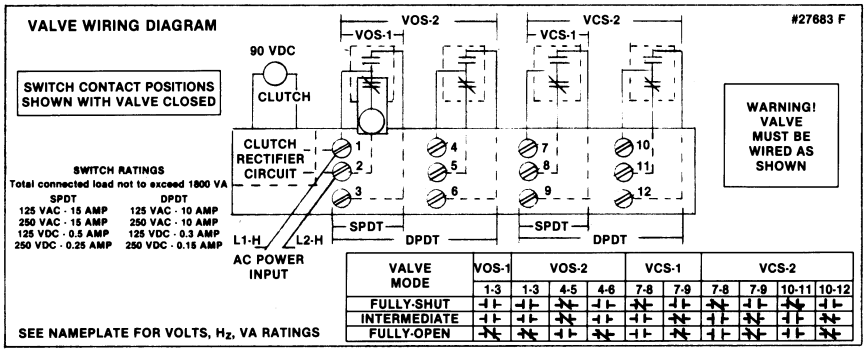
.375" – 3" Series 5000, 5100 (-S);
1" – 1.25" Series 4730, 4760, 4790 (-S);
1" – 1.25" Series 33479;
2.5" – 4" Series 5000-CP(-S); 5100-CP(-S)



4" – 6"
Series 7000, 7100 (-S)



.375" – .75"
Series 8730, 8760, and 8790 (-S)



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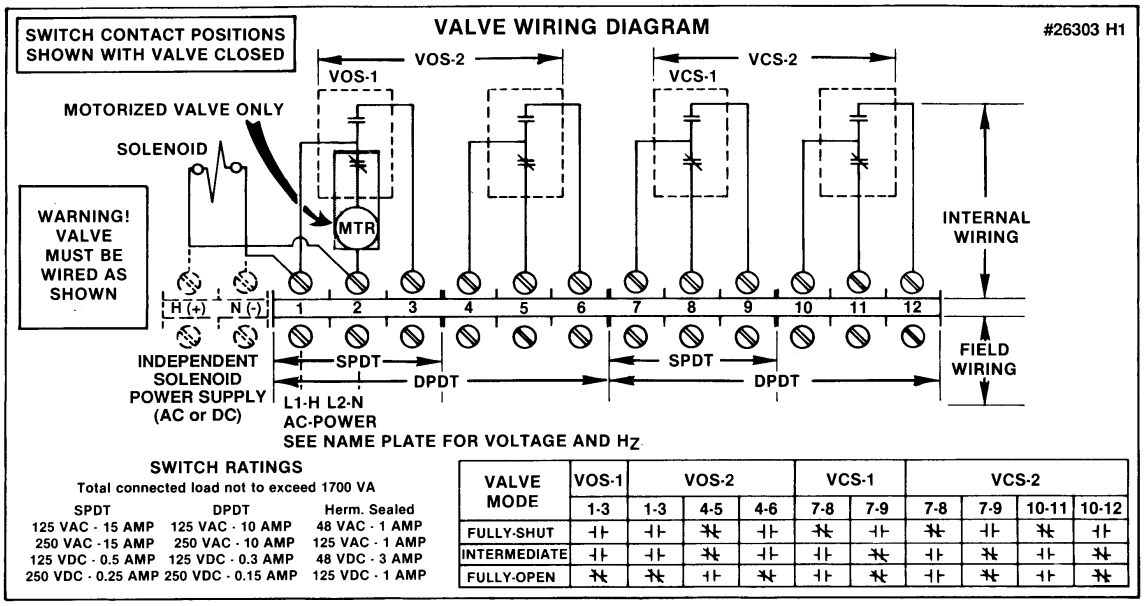
Electrical Data

Normally Open Valves

.75" – 2" Series STO-M and STO-A (-S)
2.5" – 4" Series STO-MCP and STO-ACP (-S)



SWITCH RATINGS

Total connected load not to exceed 1700 VA

SPDT	DPDT	Herm. Sealed
125 VAC - 15 AMP	125 VAC - 10 AMP	48 VAC - 1 AMP
250 VAC - 15 AMP	250 VAC - 10 AMP	125 VAC - 1 AMP
125 VDC - 0.5 AMP	125 VDC - 0.3 AMP	48 VDC - 3 AMP
250 VDC - 0.25 AMP	250 VDC - 0.15 AMP	125 VDC - 1 AMP

VALVE MODE	VOS-1	VOS-2			VCS-1		VCS-2			
	1-3	1-3	4-5	4-6	7-8	7-9	7-8	7-9	10-11	10-12
FULLY-SHUT	⊣⊢	⊣⊢	⊬	⊣⊢	⊬	⊣⊢	⊬	⊣⊢	⊬	⊣⊢
INTERMEDIATE	⊣⊢	⊣⊢	⊬	⊣⊢	⊣⊢	⊬	⊣⊢	⊬	⊣⊢	⊬
FULLY-OPEN	⊬	⊬	⊣⊢	⊬	⊣⊢	⊬	⊣⊢	⊬	⊣⊢	⊬

Tandem Arrangements

(for simultaneous opening of main and blocking valves)

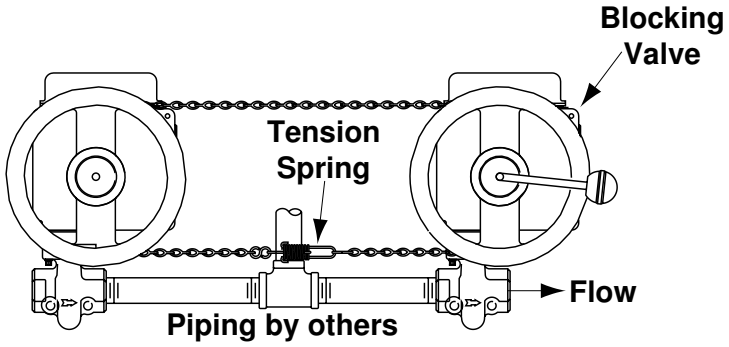
Installation Instructions

Review and comply with all general valve installation instructions provided separately. (See sketch below.)

1. Mount both valves in fuel line with center to center spacing as originally specified, and blocking valve (without handle) downstream of main valve (with handle).
2. Check valve alignment to be certain that operating wheels lie in the same plane.
3. Remove tape from the wheel of the main valve and unwind the attached chain. Do not remove the screw holding chain to wheel; it has been factory positioned to assure correct alignment. Do not remove tension spring attached to one end of chain or the wooden block insert which preloads the spring.
4. Take free end of chain and loop it around the wheels of both main and blocking valve as shown in sketch below. Depending on the specific valve series and arrangement, tension spring may be located either above or below the wheel centerline.
5. Draw free end of chain and tension spring together so that as much slack as possible is eliminated, then insert the open eye of the spring "S" hook through the link in the chain that will most nearly maintain this position.
6. Crimp the "S" hook shut around the chain link, then cut and discard excess chain.
7. Remove spring preload wood block insert from the tension spring, and verify that the chain is drawn tight.
8. Rotate the operating handle of the main valve fully to latching position for your particular valve, then hold handle firmly in this position while performing the next few steps.
9. Rotate blocking valve wheel fully counter-clockwise until it strikes a stop (it will slide within the loop of chain).
10. Still holding main valve wheel in place, move blocking valve wheel approximately 1/4 to 1/2 inch back in the clockwise direction. Insert the #10-24 X 1/2" screw (furnished) through the chain link that lines up with the tapped hole on bottom of blocking valve wheel, then fasten securely.
11. Verify that the valves are wired in parallel as shown in wiring schematic on page 6121.

To add wheel & chain assembly to existing tandem valves:

1. Verify that both valves are in the same top assembly position (TO or AW). Rotate if necessary. (See top assembly rotation instructions on pages 6100-S-3 and 6100-S-4.)
2. Bend handle of main valve outward about 25°.
3. Cut off handle of blocking valve at outer wheel face.
4. Remove hardware holding main valve wheel in place and mount new wheel and spacer to the existing wheel with new hardware provided.
5. Cut chain loop to the desired length and secure to both wheels.



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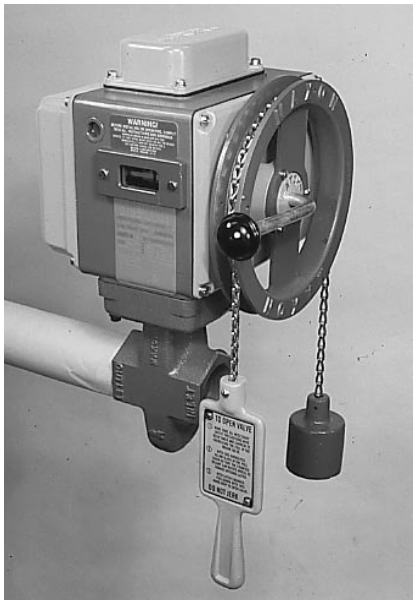
Overhead Wheel & Chain Assembly

Overhead wheel and chain assembly allows operation of a manual reset valve in an otherwise inaccessible overhead location. A wheel is mounted onto the handle of the valve. The attached chain is weighted on one end and has a paddle handgrip on the other.

Once the valve is electrically energized, pulling down on the paddle will open normally closed versions or close normally open versions.

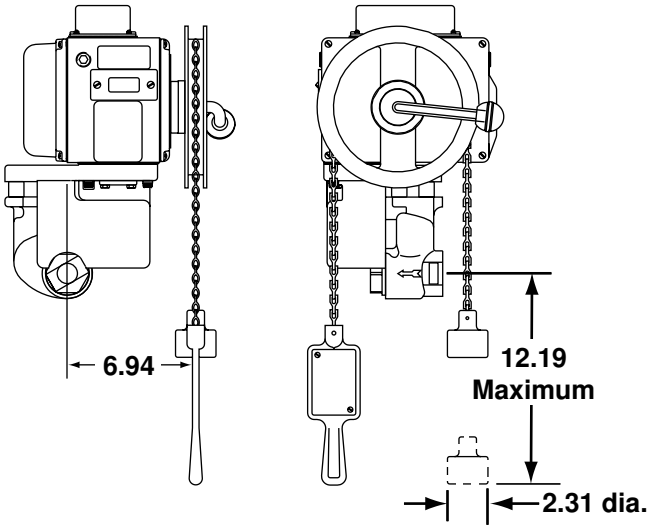
Maxon valve's free-handle design permits valve to trip to its rest position on any power interruption.

Wheel and chain assembly includes a length of chain to position the paddle handgrip slightly below pipe centerline. A standard length of 7 feet of chain is included with CP and larger valve sizes and 5 feet is included with all other valves. Extra chain (in one foot increments) may be specified to fit your specific location.

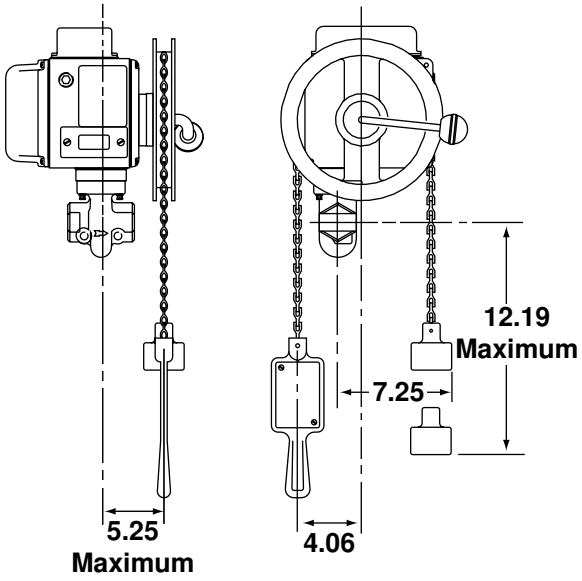


Approximate envelope dimensions *(nominal, in inches)*

Swinging gate valves



Rising stem valves



NOTE: Overhead wheel & chain can only be mounted on swinging gate valves with the top assembly position TO.

Maintenance Instructions

CAUTION: Valve leak testing should be undertaken only by trained and experienced personnel. Instructions provided by the company and/or individuals responsible for the manufacture and/or overall installation of complete system incorporating Maxon valves take precedence over these provided by Maxon. If Maxon instructions conflict with any codes or regulations, contact Maxon Corporation before attempting this procedure.

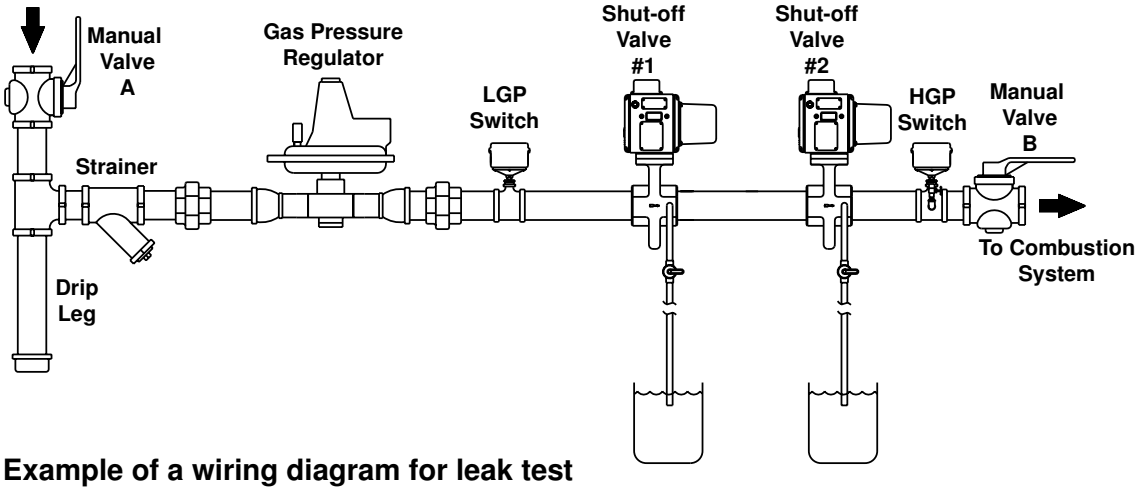
Valve leak test should be performed on a quarterly basis to assure continued safe and reliable operation. Each valve should be checked with available line pressure. Absolute zero leakage may not be obtained in the field. Any valve that exceeds the allowable leakage, as set forth by your local codes or insurance requirements (15 bubbles per minute), should be removed from service and your Maxon representative should be contacted.

Every Maxon valve is operationally tested and meets the requirements of ANSI B16.104 Class VI seat leakage when it leaves our plant.

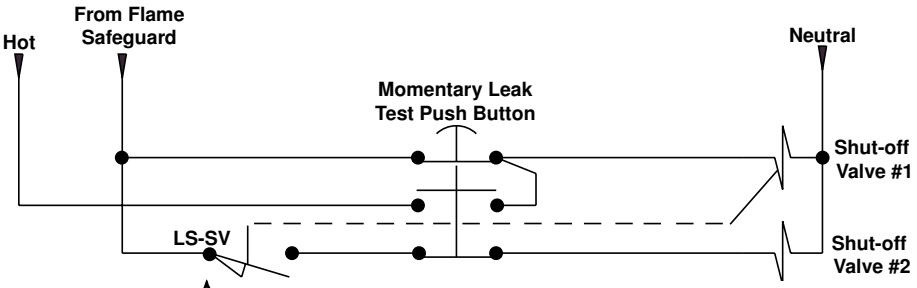
Suggested leak test procedure for double-blocking shut-off valves (without vent line)

(a) Shut down combustion system per manufacturer's recommended procedure.
(b) Close manual valves A and B.
(c) Visually inspect to verify that shut-off valves #1 and #2 are closed.
(d) Remove the 1/4" pipe plug from downstream side of shut-off valve #1. Install leak test apparatus. Safely vent any trapped gas pressure.
(e) Open manual shut-off valve A, then close leak test apparatus. Insert tube into a container of water just below the surface.
(f) Open test apparatus and test valve for leakage. As a guideline, valve should be tested for 2 minutes per inch of pipe diameter. Large diameter pipes or long piping runs between shut-off valves may need additional testing time.
(g) If valve testing indicates leakage exceeding 15 bubbles per minute, perform pre-operational exercising as outlined on Page 6100-S-2 and retest the valve. If valve continues to exceed allowable leakage limit, remove from service and contact Maxon.

Example of a gas piping diagram for leak test



Example of a wiring diagram for leak test



NOTES:
Push button must be tamper resistant.

LS-SV – Closes when Shut-off Valve #1 is fully open.

The "From Flame Safeguard" line is energized only when all conditions for safe operation have been satisfied.

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Maintenance Instructions

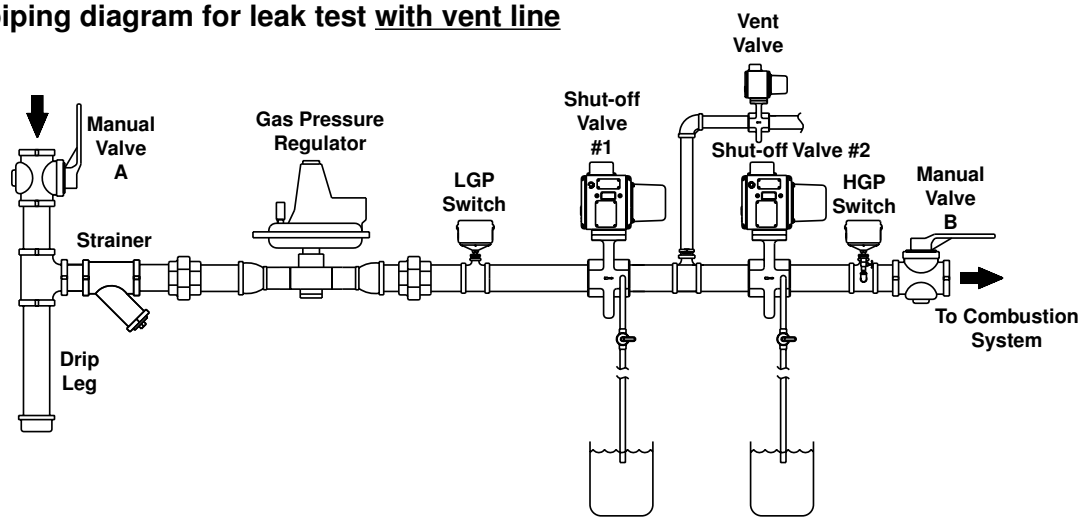
Suggested leak test procedure for double-blocking shut-off valves (without vent line) - *continued*

(h) Secure test apparatus on valve #1.
(i) Remove the 1/4" pipe plug from downstream side of shut-off valve #2. Install leak test apparatus.
(j) With an auxiliary power supply connected to valve #1, open test apparatus and test valve for leakage. As a guideline, valve should be tested for 2 minutes per inch of pipe diameter. Large diameter pipes or long piping runs between shut-off valves may need additional testing time.
(k) If valve testing indicates leakage exceeding 15 bubbles per minute, perform pre-operational exercising as outlined on Page 6100-S-2 and retest the valve. If valve continues to exceed allowable leakage limit, remove from service and contact Maxon.
(l) Secure test apparatus on valve #2.
(m) Upon completion of valve leak testing, test all other safety interlocks per manufacturer's instructions and verify they are operational.
(n) Restore combustion system to operational condition. Be sure to remove all auxiliary power supplies and jumpers that may have been used during testing.

Suggested leak test procedure for double-blocking shut-off valves <u>with vent line</u>

Example of a gas piping diagram for leak test <u>with vent line</u>

If vent valve is present, use auxiliary power supply to power vent valve to closed position during this test procedure. Follow test instructions above. Once test is complete, be sure vent valve is restored to normal operation.



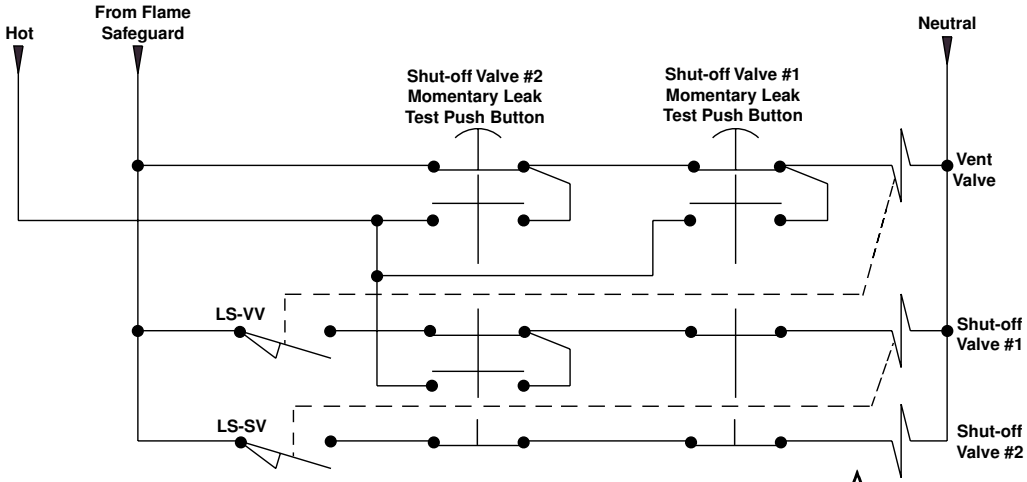
Example of a wiring diagram for leak test <u>with vent line</u>

NOTES:
Push button must be tamper resistant.

LS-VV – Closes when Vent Valve is fully closed

LS-SV – Closes when Shut-off Valve #1 is fully open.

The "From Flame Safeguard" line is energized only when sall conditions for safe operation have been satisfied.



V

COMPONENT MANUALS GEARBOXES

All GSI Hopper Bottom Dryers --- Nord #SK5382

All Zimmerman 12’ Diameter Dryers --- Sumitomo #6145DB

All Zimmerman 18’ Diameter Dryers --- Sumitomo #6185DB

All Zimmerman 24’ Diameter Dryers --- Sumitomo #6195DB

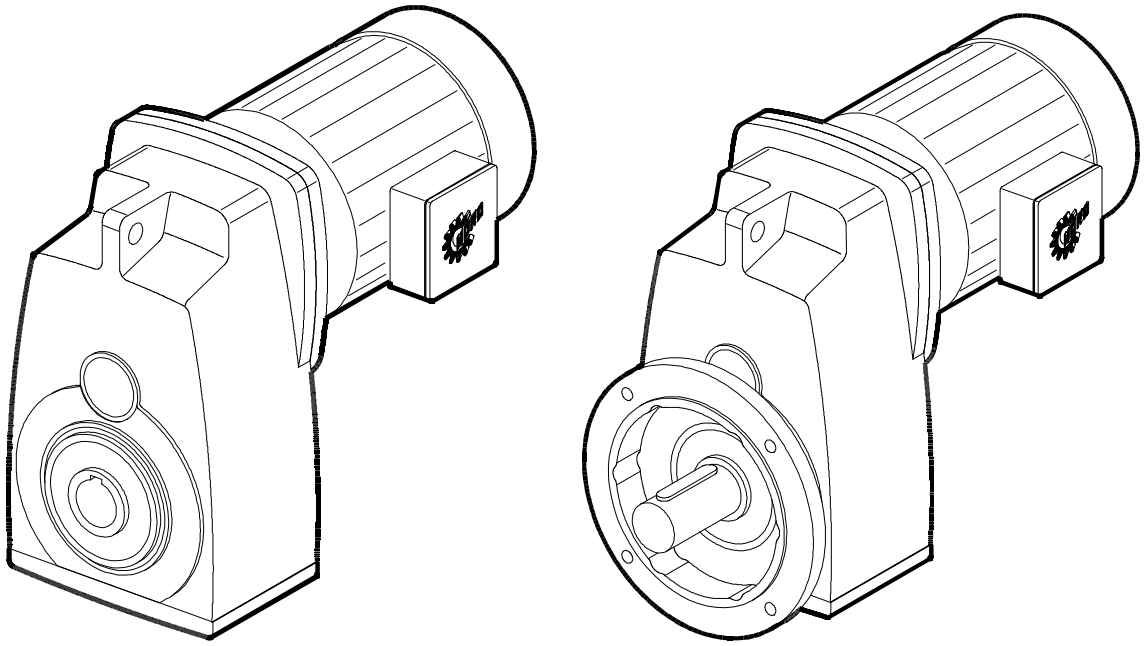
UNICASE® Shaft Mount Gearboxes
Installation and Maintenance Instructions

BIM 1020

USA

CDN

Retain These Safety Instructions For Future Use



INSPECTION OF UNIT

Thoroughly inspect the equipment for any shipping and handling damage before accepting shipment from the freight company. If any of the goods called for in the bill of lading or express receipt are damaged or the quantity is short, do not accept until the freight or express agent makes an appropriate notation on your freight bill or express receipt. If any concealed loss or damage is discovered later, notify your freight carrier or express agent at once and request him to make an inspection. We will be very happy to assist you in collecting claims for loss or damage during shipment; however, this willingness on our part does not remove the transportation company's responsibility in reimbursing you for collection of claims or replacement of material. Claims for loss or damage in shipment must not be deducted from the NORD Gear invoice, nor should payment of the NORD Gear invoice be withheld awaiting adjustment of such claims, as the carrier guarantees safe delivery.

If considerable damage has been incurred and the situation is urgent, contact the nearest NORD Gear Sales Office for assistance. Please keep a written record of all communications.

RECORD NAMEPLATE DATA

Locate the gear reducer nameplate and record all nameplate data for future reference.

SK _____ S/N _____

RATIO _____ MAX TORQUE _____ RPM _____ MTG. POS _____

STORAGE

PROPER STORAGE UNTIL INSTALLED

Keep unit in a dry, temperature controlled area. If stored other than said, long term storage methods must be applied to the unit including complete fill with lubricant. Protect machined surfaces and rotate shafts periodically. Prior to putting unit into service, drain lubricant and refill to proper level as determined by the mounting position.

PROPER HANDLING OF THE UNIT

Exercise care to prevent damage to the unit when moving. Lift only at designed lifting points. Do not attach other machinery and lift by the unit lifting points. The lifting points are to be used to lift the unit only. Insure that adequate safety measures are taken to protect personnel during transportation. Protect the mounting surface from damage.

INSTALLATION OF UNIT

To ensure long service and dependable performance, an enclosed gear drive must be rigidly supported and the shafts accurately aligned. The following describes the minimum precautions required to accomplish this end.

FOUNDATION
The responsibility for the design and construction of the foundation lies with the user. The foundation must be adequate to withstand normal operating loads and possible overloads while maintaining alignment to attached system components under such loads.

MOUNTING POSITION
Unless a unit is specifically ordered for inclined mounting, the foundation must be level and flat. The lubrication system may not operate properly if the unit is not mounted in the position for which it is designed. It may be desirable to elevate the foundation to facilitate oil drainage.

CONCRETE FOUNDATION
If a concrete foundation is used, steel mounting pads and bolts of sufficient size to distribute the stress into the concrete should be grouted into the foundation.

STEEL FOUNDATION
If a structural steel foundation is used (i.e. wide flange beams or channels), a base plate or sole plate of suitable thickness should be used and should extend under the entire unit.

FOOT MOUNTED UNITS
Use shims under the feet of the unit to align the output shaft to the driven equipment. Make sure that all feet are supported so that the housing will not distort when it is bolted down. Improper shimming will reduce the life of the unit and may cause failure. Dowel pins may be installed to prevent misalignment and ensure proper realignment if removed for service.

SHAFT MOUNTED UNITS
Shaft mounted drives should be mounted as close to the driven equipment bearing support as possible to minimize bearing loads due to overhung load. Design of the joint connection between the torque reaction arm and the foundation is the user's responsibility.

Hollow Shaft Diameter tolerance
Metric (mm)

≤ ∅ 18 = +0.018/-0.000
> ∅ 18 ≤ ∅ 30 = +0.021/-0.000
> ∅ 30 ≤ ∅ 50 = +0.025/-0.000
> ∅ 50 ≤ ∅ 80 = +0.030/-0.000
> ∅ 80 ≤ ∅ 120 = +0.035/-0.000
> ∅ 120 ≤ ∅ 180 = +0.040/-0.000

Inch

≤ ∅ 4.375 = +0.0010 / -0.0000
> ∅ 4.375 = +0.0015 / -0.0000

Customer shaft diameter tolerances with keyed hollow shafts
Metric (mm)

≤ ∅ 18 = +0.000/-0.011
> ∅ 18 ≤ ∅ 30 = +0.000/-0.013
> ∅ 30 ≤ ∅ 50 = +0.000/-0.016
> ∅ 50 ≤ ∅ 80 = +0.000/-0.019
> ∅ 80 ≤ ∅ 120 = +0.000/-0.022
> ∅ 120 ≤ ∅ 180 = +0.000/-0.025

Inch

≤ ∅ 1.500 = +0.000/-0.002
> ∅ 1.500 ≤ ∅ 2.500 = +0.000/-0.003
> ∅ 2.500 ≤ ∅ 7.000 = +0.000/-0.004

Shaft finish to be 125 micro inches or smoother.

Customer shaft diameter tolerance with Shrink Disc fit h6
Metric (mm)

≤ ∅ 18 = +0.000/-0.011
> ∅ 18 ≤ ∅ 30 = +0.000/-0.013
> ∅ 30 ≤ ∅ 50 = +0.000/-0.016
> ∅ 50 ≤ ∅ 80 = +0.000/-0.019
> ∅ 80 ≤ ∅ 120 = +0.000/-0.022
> ∅ 120 ≤ ∅ 180 = +0.000/-0.025

Inch

≤ ∅ 0.750 = +0.0000/-0.0004
> ∅ 0.750 ≤ ∅ 1.125 = +0.0000/-0.0005
> ∅ 1.125 ≤ ∅ 2.000 = +0.0000/-0.0006
> ∅ 2.000 ≤ ∅ 3.000 = +0.0000/-0.0007
> ∅ 3.000 ≤ ∅ 4.750 = +0.0000/-0.0008
> ∅ 4.750 ≤ ∅ 7.000 = +0.0000/-0.0010

Shaft finish to be 125 micro inches or smoother.

Customer shaft diameter tolerance with Shrink Disc fit f6 (looser fit)
Metric (mm)

≤ ∅ 18 = -0.016/-0.024
> ∅ 18 ≤ ∅ 30 = -0.020/-0.029
> ∅ 30 ≤ ∅ 50 = -0.025/-0.036
> ∅ 50 ≤ ∅ 80 = -0.030/-0.043
> ∅ 80 ≤ ∅ 120 = -0.036/-0.051
> ∅ 120 ≤ ∅ 180 = -0.043/-0.061

Inch

≤ ∅ 0.750 = -0.0006/-0.0011
> ∅ 0.750 ≤ ∅ 1.125 = -0.0008/-0.0013
> ∅ 1.125 ≤ ∅ 2.000 = -0.0010/-0.0016
> ∅ 2.000 ≤ ∅ 3.000 = -0.0012/-0.0019
> ∅ 3.000 ≤ ∅ 4.750 = -0.0014/-0.0023
> ∅ 4.750 ≤ ∅ 7.000 = -0.0017/-0.0027

Shaft finish to be 125 micro inches or smoother

FLANGE MOUNTED UNITS
If a structural steel foundation is used (i.e. wide flange beams or channels), a base plate or sole plate of suitable thickness should be used and should extend under the entire unit. If a bulk head plate is used it should be of proper strength to minimize buckling distortions.

Flange Pilot 'AK' or 'AK1' tolerance
Metric (mm)

> ∅ 50 ≤ ∅ 80 = +0.012/-0.007
> ∅ 80 ≤ ∅ 120 = +0.013/-0.009
> ∅ 120 ≤ ∅ 180 = +0.014/-0.011
> ∅ 180 ≤ ∅ 230 = +0.016/-0.013
> ∅ 230 ≤ ∅ 315 = +0.000-0.032
> ∅ 315 ≤ ∅ 400 = +0.000/-0.036
> ∅ 400 ≤ ∅ 500 = +0.000/-0.040

Inch

> ∅ 1.969 ≤ ∅ 3.150 = +0.005/-0.0003
> ∅ 3.150 ≤ ∅ 4.724 = +0.005/-0.0004
> ∅ 4.724 ≤ ∅ 7.087 = +0.006/-0.0004
> ∅ 7.087 ≤ ∅ 9.055 = +0.006/-0.0005
> ∅ 9.055 ≤ ∅ 12.402 = +0.000/-0.0013
> ∅ 12.402 ≤ ∅ 15.748 = +0.000/-0.0014
> ∅ 15.748 ≤ ∅ 19.685 = +0.000/-0.0016

BOLT STRENGTH
Bolt size, strength and quantity should be verified to insure proper torque reaction capacity whatever the mounting arrangement.

LUBRICATE SHAFTS
Both the hollow shaft and the driven shaft should be liberally lubricated before assembly. The unit must slide freely onto the driven shaft. Do not hammer or force the unit into place. For shrink disc, follow instructions below.

AXIAL RETENTION
Each drive shaft must be retained in place relative to the gear reducer. Or each gear reducer must be retained in place relative to the drive shaft. Either way NORD recommends the use of shaft shoulders, locking collars or FIXING ELEMENTS to axially retain the shaft or gear reducer in position.

SET SCREWS
If set screws are used for axial retention, they should be tightened evenly. Flats may be filed on the driven shaft and a thread-locking adhesive used for more position retention.

SNAP RING RETENTION
Placing external snap rings on drive shafts must be performed with caution. The groove, which the snap ring fits into, may weaken the drive shaft causing premature failure. NORD does not recommend this type of shaft retention.

THRUST PLATE
In applications, which are subject to high vibratory loads, a thrust plate will provide greater resistance to axial movement. Follow the manufacturer's recommendations for assembly.

SHRINK DISC
If a shrink disc is used to secure a reducer hollow shaft to the driven shaft, follow this assembly procedure. Start with the shrink disc mounted onto the extension of the hollow shaft disc locking bolts loosened.

1. Clean reducer bore and mating solid shaft to be free of any lubricants or dirt.
2. Slide reducer onto the solid shaft until it is about half way through.
3. Lubricate the remaining portion of the solid shaft with a #2 grease or similar lubricant. This part will be located under the bronze bushing. **Do not install grease under the shrink disc gripping area.** Finish installing the solid shaft into the reducer hollow bore.
4. Finger tighten all shrink disc bolts. Now, moving a circular pattern, tighten each shrink disc locking bolt 1/4 to 1/2 turn. **Do not use criss cross pattern.** Continue tightening in the same circular direction with 1/4 or 1/2 turn increments until all bolts reach the specified bolt tightening torque. Bolt tightening torque is shown on the shrink disc label for the particular unit.
5. Run unit for 24 hours, then retighten shrink disc locking bolts to the proper bolt torque as indicated above.

TORQUE REACTION ARM
On the shaft mount 'Clincher', torque is reacted through the integral torque tab, which is part of the casting. Commonly, NORD's optional RUBBER BUFFER bushings are installed on each side of the integral torque tab to dampen torque shocks and allow for mis-alignment received from the machinery during operation.

Torque arm connection fabrications should always be mounted perpendicular to a line through the output shaft center and the point at attachment of the torque arm to the unit housing. In this position the minimum load on the attachment structure arm will be experienced. The attachment structure must be rigid and may not deflect under any load. Doing so will place extra loads on the output bearings of the reducer.

PRIME MOVER MOUNTING
Align the prime mover to the reducer-input shaft using shims under the feet. Make sure that the feet are supported. Dowel the prime mover to its foundation.

SHAFT CONNECTIONS
When connecting shafts to either the input or output of the reducer, consider the following instructions.

FITS
Clearance or interference fits for coupling hubs should be in accordance with ANSI/AGMA 9002-A86 or as follows.

Output and Input shaft Diameter tolerance
Metric (mm)

≤ ∅ 18 = +0.012/+0.001
> ∅ 18 ≤ ∅ 30 = +0.015/+0.002
> ∅ 30 ≤ ∅ 50 = +0.018/+0.002
> ∅ 50 ≤ ∅ 80 = +0.030/+0.011
> ∅ 80 ≤ ∅ 120 = +0.035/+0.013
> ∅ 120 ≤ ∅ 180 = +0.040/+0.015

Inch

≤ ∅ 1.750 = +0.0000/-0.0005
> ∅ 1.750 = +0.0000/-0.0010

Output and Input shaft Drill and tap shaft end
Metric (mm)

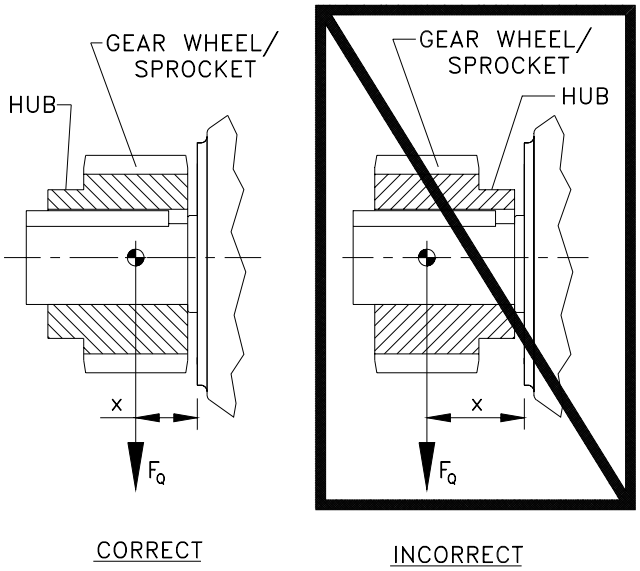
≤ ∅ 16 = M5
> ∅ 16 ≤ ∅ 21 = M6
> ∅ 21 ≤ ∅ 24 = M8
> ∅ 24 ≤ ∅ 30 = M10
> ∅ 30 ≤ ∅ 38 = M12
> ∅ 38 ≤ ∅ 50 = M16
> ∅ 50 ≤ ∅ 85 = M20
> ∅ 85 ≤ ∅ 130 = M24

Inch

≤ ∅ 0.438 = #10-24 x 0.4 deep
> ∅ 0.438 ≤ ∅ 0.813 = 1/4-20 x 0.6 deep
> ∅ 0.813 ≤ ∅ 0.938 = 5/16-18 x 0.7 deep
> ∅ 0.938 ≤ ∅ 1.125 = 3/8-16 x 0.9 deep
> ∅ 1.125 ≤ ∅ 1.375 = 1/2-13 x 1.1 deep
> ∅ 1.375 ≤ ∅ 1.875 = 5/8-11 x 1.4 deep
> ∅ 1.875 ≤ ∅ 3.250 = 3/4-10 x 1.7 deep
> ∅ 3.250 = 1-8 x 2.2 deep

Outboard pinion and sprocket fits should be as recommended by the pin sprockets with interference fits should be heated according to the manufacturer's recommendations, generally 250°F to 300°F, (120°C to 150° C) before assembling to the shaft.

LOCATION
Coupling hubs should be mounted flush with the shaft ends, unless specifically ordered for overhung mounting. Pinions,



sprockets and sheaves should be mounted as close as possible to the unit housing to minimize bearing loads and shaft deflections.

COUPLING ALIGNMENT
Shaft couplings should be installed according to the coupling manufacturer's recommendations for gap, angular and parallel alignment. In many installations, it is necessary to allow for thermal and mechanical shaft movement when determining shaft alignment. The coupling manufacturer's recommendations should be followed.

AXIAL DISPLACEMENT
The gap between shaft ends should be the same as the specified coupling gap unless overhung mounting of the coupling hub is specified. The coupling gap and shaft gap must be sufficient to accommodate any anticipated thermal or mechanical axial movement.

ANGULAR ALIGNMENT
Insert a spacer or shim stock equal to the required coupling gap between the coupling hub faces and measure the clearance using feeler gauges. Repeat this at the same depth at 90-degree intervals to determine the amount of angular misalignment.

PARALLEL ALIGNMENT
Mount a dial indicator to one coupling hub, and rotate this hub, sweeping the outside diameter of the other hub. The parallel misalignment is equal to one-half of the total indicator reading. Another method is to rest a straight edge squarely on the outside diameter of the hubs at 90-degree intervals and measure any gaps with feeler gauges. The maximum gap measurement is the parallel misalignment.

CHECKING ALIGNMENT
After both angular and parallel alignments are within specified limits, tighten all foundation bolts securely and repeat the above procedure to check alignment. If any of the specified limits for alignment are exceeded, realign the coupling.

SPROCKET OR SHEAVE ALIGNMENT
Align the sheaves or sprockets square and parallel by placing a straight edge across their faces. Alignment of bushed sheaves and sprockets should be checked after bushings have been tightened. Check horizontal shaft alignment by placing a level vertically against the face of the sheave or sprocket. Adjust belt or chain tension per the manufacturer's specified procedure.

OUTBOARD PINION ALIGNMENT
Align the pinion by adjusting the gear tooth clearance according to the manufacturer's recommendations and checking for acceptable outboard pinion tooth contact. The foundation bolts may have to be loosened and the unit moved slightly to obtain this contact. When the unit is moved to correct tooth contact, the prime mover should be realigned.

RECHECK ALIGNMENT
After a period of operation, recheck alignment and adjust as required.

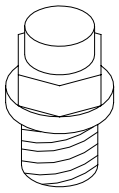
1. Properly install unit on a rigid foundation
   - adequately supported
   - securely bolted into place
   - leveled so as not to distort the gear case
2. Properly install couplings suitable for the application and connected equipment.
3. Ensure accurate alignment with other equipment.
4. Furnish and install adequate machinery guards as needed to protect operating personnel and as required by the applicable standards of the Occupational Safety and Health Administration (OSHA), and by other applicable safety regulations;
5. Ensure that driving equipment is running in the correct direction before coupling to reducers with backstops (designed to operate only in a specific direction) or machinery designed to operate only in one direction.

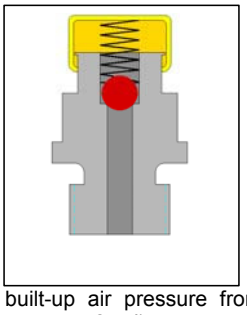
CHANGES IN PERFORMANCE SPECIFICATIONS
Owner has the responsibility to consult with NORD GEAR if such items such as applied loads, operating speeds or other operating conditions have changed.

WARNING:
LOCK OUT POWER before any maintenance is performed. Make absolutely sure that no voltage is applied while work is being done on the gearbox.

START-UP
1. Ensure that switches, alarms, heaters, coolers and other safety and protection devices are installed and operational for their intended purpose.
2. Verify that the installed mounting position is the same as the nametag mounting position. If not, adjust the oil level accordingly and relocate the vent plug, fill plug and drain plug according to the mounting position. See following.

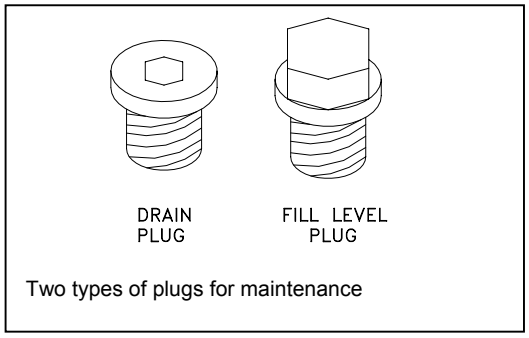
AUTOVENT PLUG
The Autovent plug is brass in color and will be located at the highest point on the gearbox. It operates like a check-valve to allow the reducer to relieve internal pressure while preventing lubricant contamination during cooling. A spring presses a ball or plunger against a machined orifice until pressure exceeds 2 psi. Above 2 psi the air is allowed to escape depressurizing the gearcase. When internal pressure drops below 2 psi, the autovent re-seals closing the unit to the outside environment. After shutdown, the reducer cools along with the air inside the reducer. The unit will temporarily maintain a slight vacuum until normalization occurs. NORD Gear supplies an Autovent as a standard feature.


AUTOVENT PLUG



The Autovent releases built-up air pressure from inside the gearbox (Max. pressure 2 psi).

FILL LEVEL & DRAIN PLUGS
The drain plugs are metric socket head cap screws. They will be located at the lowest part of the gearbox for ease of draining. The fill level plug is a hex head cap screw. It will be located between the Autovent and drain plug. Both types of plugs will have gaskets included to prevent oil from leaking.



Two types of plugs for maintenance

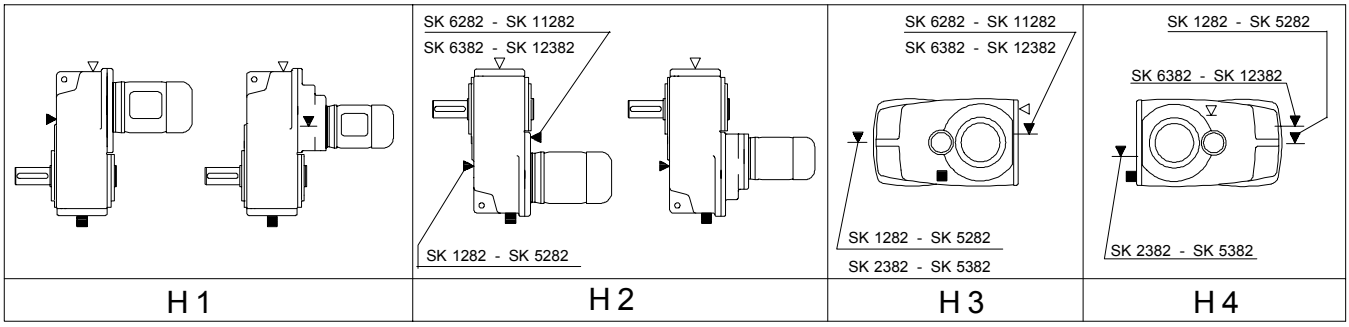
LUBRICANT
All NORD reducers are shipped from the factory properly filled with lubricant and all plugs are installed according to the mounting position given on the reducer nametag. Acceptable oil fill level is within ½ inch of the bottom of the fill plug threads.

OPERATION AND MAINTENANCE CHECKLIST
1. Operate the equipment as it was intended to be operated
2. Do not overload.
3. Run at correct speed.
4. Maintain lubricant in good condition and at proper level.
5. Dispose of used lubricant in accordance with applicable laws and regulations.
6. Apply proper maintenance to attached equipment at prescribed intervals recommended by the manufacturer.
7. Perform periodic maintenance of the gear drive as recommended by NORD.

MOUNTING POSITIONS

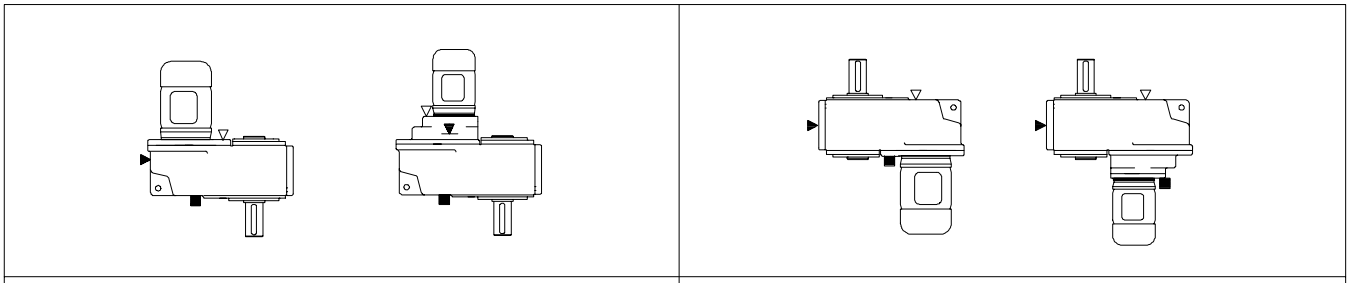
These charts detail the mounting positions for horizontal and vertical mounting. The Autovent, oil fill plug and drain plug are indicated on each mounting position picture. The factory set mounting position and plug locations match that shown on the gearbox nametag. For mounting orientations other than shown consult NORD Gear.

Horizontal position



H 1	H 2	H 3	H 4

Vertical position



H 5 *	H 6

Symbols: Vent plug Oil level Drain plug

* Mounting position H5 with lubricant expansion unit recommended

SK0182NB & SK1382NB have no vent or drain plugs. They are filled with synthetic oil so the units are "Lubed for Life".

MAINTENANCE

Mineral lubricant should be changed every 10,000 service hours or after two years. For synthetic oils, the lube should be changed every 20,000 service hours or after four years. In case of extreme operating (e.g. high humidity, aggressive environment or large temperature variations), shorter intervals between changes are recommended.

OIL SPECIFICATIONS

NORD supplies all reducers filled with oil from the factory. Consult the sticker adjacent to the fill plug to determine the type of lubricant installed at the factory. Standard lubricant is ISO VG220 mineral-based oil. However, some units have special lubricants designed to operate in certain environments or to extend the service life of the lubricant. If in doubt about which lubricant is needed, contact NORD Gear.

STANDARD OIL – ISO VG220

Ambient Temperature	Formulation
20 to 104°F (-5 to 40°C)	Mineral

TYPICAL OILS

Viscosity ISO NLGI	Formulation	Service Temperature Range	Mobil	Shell	Castrol	KLÜBER LUBRICATION	bp	Tribol
VG 460	Conventional Mineral	20°C to +50°C 68F to +122°F	Mobilgear 634	Omala 460	7EP	Klüberoil GEM 1-460	Energol GR-XP 460	Tribol 1100/460
	Synthetic PAO	-30°C to +80°C -22°F to +176°F	Mobil SHC 634	Omala 460 HD	Isolube EP 460	Klübersynth EG 4-460	N/A	Tribol 1510/460
VG 320	Conventional Mineral	0°C to +30°C 32°F to +86°F	Mobilgear 632	Omala 320	6EP	Klüberoil GEM 1-320	Energol GR-XP 320	Tribol 1100/320
	Synthetic PAO	-35°C to +80°C -31°F to +176°F	Mobil SHC 632	Omala 320 HD	Isolube EP 460	Klübersynth EG 4-320	N/A	Tribol 1510/320
VG 220	Conventional Mineral	-5°C to +40°C +20°F to +104°F	Mobilgear 630	Omala 220	5EP	Klüberoil GEM 1-220	Energol GR-XP 220	Tribol 1100/220
	Synthetic PAO	-34°C to +80°C -30°F to +176°F	Mobil SHC 630	Omala 220 HD	Isolube EP 220	Klübersynth EG 4-220	N/A	Tribol 1510/220
VG 150 & VG 100	Conventional Mineral	-15°C to +25°C 5°F to +77°F	Mobilgear 629	Omala 100	4EP	Klüberoil GEM 1-150	Energol GR-XP 100	Tribol 1100/100
	Synthetic PAO	-37°C to +10°C -35°F to +50°F	Mobil SHC 629	Omala 150 HD	Isolube EP 150	Klübersynth EG 4-150	N/A	N/A
VG 68	Conventional Mineral	-15°C to +25°C 5°F to +77F	Mobilgear 626	Omala 68	2EP	Klüberoil GEM 1-68	Energol GR-XP 68	Tribol 1100/68
	Synthetic PAO	-40°C to +10°C -40°F to +50F	Mobil SHC 626	N/A	Isolube EP 68	N/A	N/A	N/A
VG 32	Synthetic PAO	-40°C to +10°C -40°F to +50°F	Mobil SHC 624	N/A	N/A	Klüber-Summit HySyn FG-32	N/A	N/A

PAO = Poly Alpha Olefin

SPECIAL PURPOSE LUBRICANTS

Ambient Temperature	Formulation	Manufacturer	Oil Brand Name
20 to 104°F (-5 to 40°C)	*Food Grade* Oil - Synthetic	Chevron	FM ISO 220
20 to 104°F (-5 to 40°C)	*Food Grade* Oil - Synthetic	OilJAX	Magnaplate 85W140-FG
5 to 125°F (-20 to 50°C)	Fluid Grease	Mobil	Mobilux EP023
-30 to 140°F (-35 to 60°C)	Fluid Grease - Synthetic	Mobil	Mobilith SHC 007
-30 to 140°F (-35 to 60°C)	Fluid Grease - Synthetic	Shell	Albida LC

STANDARD BEARING GREASE – NLGI 2EP Lithium

Ambient Temperature	Formulation
-20 to 140°F (-30 to 60°C)	Mineral

OPTIONAL BEARING GREASES

Ambient Temperature	Formulation	Manufacturer	Grease Brand Name
-40 to 230°F (-40 to 110°C)	Synthetic	Shell	Aeroshell 6
-40 to 230°F (-40 to 110°C)	*Food Grade* - Synthetic	Lubriplate	SFL1

LUBRICANT CAPACITY

Each reducer has the oil level and oil quantity adjusted according to the mounting position shown in the tables. When replacing the oil, consult the tables below to determine the proper amount of oil to be installed according to the reducer size and mounting position. Note that this is approximate and the final level will be adjusted when the reducer is installed. Acceptable oil fill level is within ½ inch of the bottom of the fill plug threads.

LUBRICATION CAPACITY - SHAFT MOUNT 'CLINCHER' GEARBOXES

		MOUNTING POSITION					
		Horizontal				*Vertical*	
		H1	**H2**	**H3**	**H4**	**H5**	**H6**
SK 0182NB	quarts	0.42	0.63	0.53	0.53	0.58	0.58
	liters	0.40	0.60	0.50	0.50	0.55	0.55
SK0282NB	quarts	0.74	0.85	0.95	0.95	1.16	1.06
	liters	0.70	0.80	0.90	0.90	1.10	1.00
SK 1282	quarts	0.95	0.95	1.00	1.00	1.27	1.37
	liters	0.90	0.90	0.95	0.95	1.20	1.30
SK 2282	quarts	1.74	2.01	1.90	1.90	2.11	2.54
	liters	1.65	1.90	1.80	1.80	2.00	2.40
SK 3282	quarts	3.33	3.44	3.33	3.33	4.33	4.33
	liters	3.15	3.25	3.15	3.15	4.10	4.10
SK 4282	quarts	4.97	5.02	4.97	4.97	5.71	6.45
	liters	4.70	4.75	4.70	4.70	5.40	6.10
SK 5282	quarts	7.93	7.93	7.61	7.61	9.30	9.30
	liters	7.50	7.50	7.20	7.20	8.80	8.80
SK 6282	quarts	18.0	12.7	14.8	10.6	18.5	14.8
	liters	17.0	12.0	14.0	10.0	17.5	14.0
SK 7282	quarts	26.4	21.1	22.2	16.9	28.5	22.2
	liters	25	20	21	16	27	21
SK 8282	quarts	39.1	31.7	32.8	32.8	43.3	34.9
	liters	37	30	31	31	41	33
SK 9282	quarts	78.2	58.1	62.4	72.9	76.1	74.0
	liters	74	55	59	69	72	70
SK 10282	quarts	95	42	87	63	95	95
	liters	90	40	82	60	90	90
SK 11282	quarts	174	153	148	106	206	169
	liters	165	145	140	100	195	160

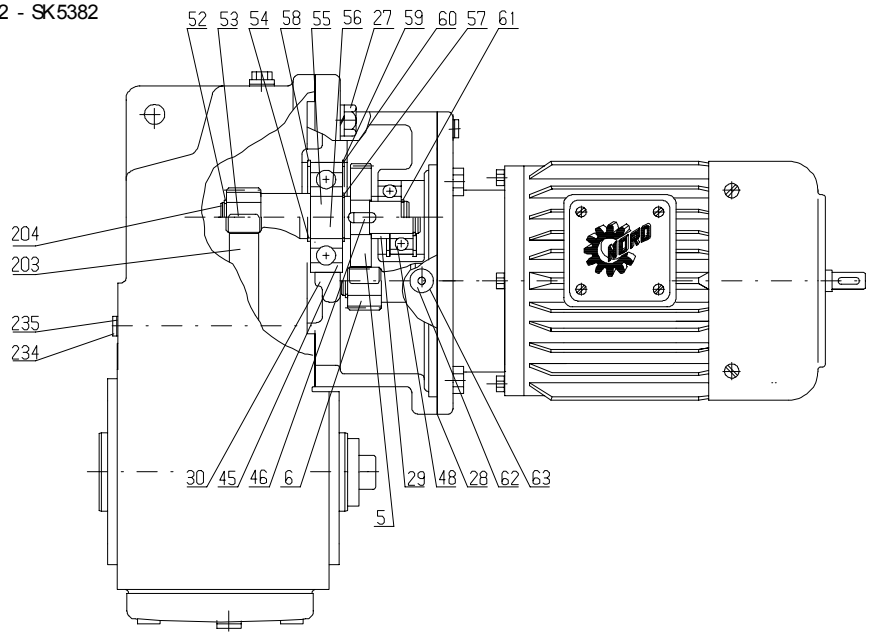
		MOUNTING POSITION					
		Horizontal				*Vertical*	
		H1	**H2**	**H3**	**H4**	**H5**	**H6**
SK 1382NB	quarts	1.37	1.48	2.01	2.11	2.22	2.43
	liters	1.30	1.40	1.90	2.00	2.10	2.30
SK 2382	quarts	1.80	2.01	1.59	1.59	3.28	2.75
	liters	1.70	1.90	1.50	1.50	3.10	2.60
SK 3382	quarts	4.33	3.49	3.49	3.49	5.92	4.33
	liters	4.10	3.30	3.30	3.30	5.60	4.10
SK 4382	quarts	6.24	5.18	5.18	5.18	8.77	7.19
	liters	5.90	4.90	4.90	4.90	8.30	6.80
SK 5382	quarts	13.21	7.08	8.77	8.77	14.80	12.68
	liters	12.50	6.70	8.30	8.30	14.00	12.00
SK 6382	quarts	17.4	10.1	13.2	14.8	19.0	13.7
	liters	16.5	9.6	12.5	14.0	18.0	13.0
SK 7382	quarts	23.3	16.9	20.1	24.3	26.4	21.1
	liters	22	16	19	23	25	20
SK 8382	quarts	35.9	26.4	31.7	37.0	40.2	33.8
	liters	34	25	30	35	38	32
SK 9382	quarts	77.2	47.6	63.4	68.7	78.2	74.0
	liters	73	45	60	65	74	70
SK 10382	quarts	90	77	85	85	93	93
	liters	85	73	80	80	88	88
SK 11382	quarts	169	148	143	164	222	164
	liters	160	140	135	155	210	155
SK 12382	quarts	169	148	143	164	222	164
	liters	160	140	135	155	210	155

Note: Filling quantities are approximate figures. Oil level must be checked according to oil level plug after final installtion.

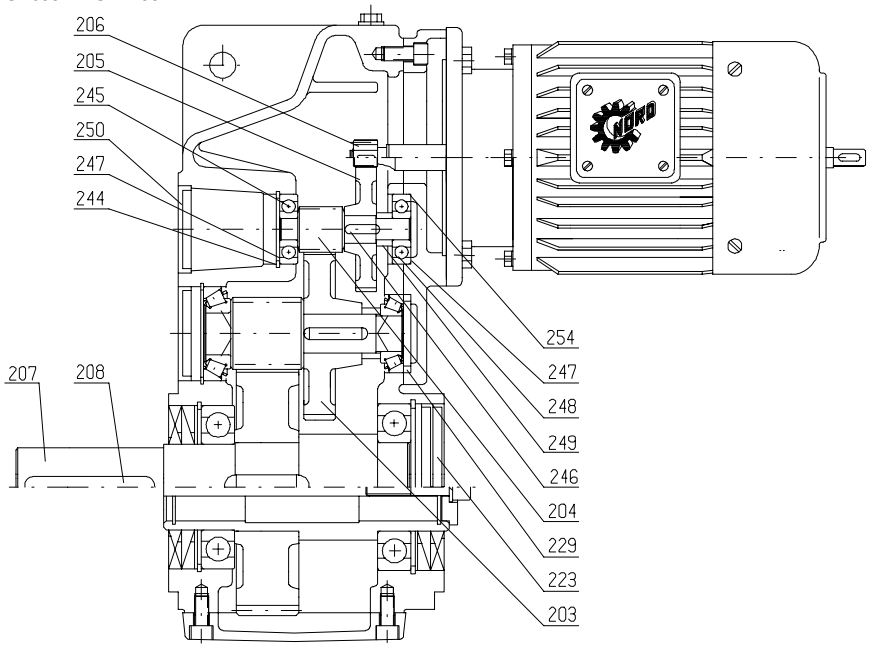
Acceptable oil fill level is within 1/2 inch of the bottom of the fill plug threads. For mounting angles not shown, consult factory.

PARTS LIST

SK 1382 - SK 5382



SK 6382 - SK 11382



5	Driving gear
27	Hexagon screw
28	Seal
29	Supporting disc
30	Third reduction gearcase
45	Ball bearing
46	Key
48	Ball bearing
52	Circlip
53	Key
54	Circlip
55	Intermediate shaft, plain
56	Intermediate shaft, gearcut
57	Circlip
58	Circlip
59	Shim
60	Circlip
61	Circlip
62	Drain plug
63	Seal
203	Driving gea
204	Pinion shaft SK 6382 - SK 9382
206	Driving pinion
207	Output shaft
208	Key
223	Locking cap
229	Supporting disc
234	Drain plug
235	Seal
244	Circlip
245	Ball bearing
246	Key
247	Shim
248	Ball bearing
249	Supporting disc
250	Locking cap
254	Spacer

TROUBLE SHOOTING

PROBLEM WITH THE REDUCER		POSSIBLE CAUSES	SUGGESTED REMEDY
Runs Hot	Overloading	Load exceeds the capacity of the reducer	Check rated capacity of reducer, replace with unit of sufficient capacity or reduce load
	Improper lubrication	Insufficient lubrication	Check lubricant level and adjust up to recommended levels
		Excessive lubrication	Check lubricant level and adjust down to recommended levels
		Wrong lubrication	Flush out and refill with correct lubricant as recommended
Runs Noisy	Loose foundation bolts	Weak mounting structure	Inspect mounting of reducer. Tighten loose bolts and/ or reinforce mounting and structure
		Loose hold down bolts	Tighten bolts
	Worn RV Disc	Overloading unit may result in damage to disc	Disassemble and replace disc. Recheck rated capacity of reducer.
	Failure of Bearings	May be due to lack of lubricant	Replace bearing. Clean and flush reducer and fill with recommended lubricant.
		Overload	Check rated capacity of reducer.
	Insufficient Lubricant	Level of lubricant in the reducer not properly maintained.	Check lubricant level and adjust to factory recommended level.
Output Shaft Does Not Turn	Internal parts are broken	Overloading of reducer can cause damage.	Replace broken parts. Check rated capacity of reducer.
		Key missing or sheared off on input shaft.	Replace key.
		Coupling loose or disconnected.	Properly align reducer and coupling. Tighten coupling.
Oil Leakage	Worn Seals	Caused by dirt or grit entering seal.	Replace seals. Autovent may be clogged. Replace or clean.
		Overfilled reducer.	Check lubricant level and adjust to recommended level.
		Autovent clogged.	Clean or replace, being sure to prevent any dirt from falling into the reducer.
		Improper mounting position, such as wall or ceiling mount of horizontal reducer.	Check mounting position. Name tag & verify with mounting chart in manual.

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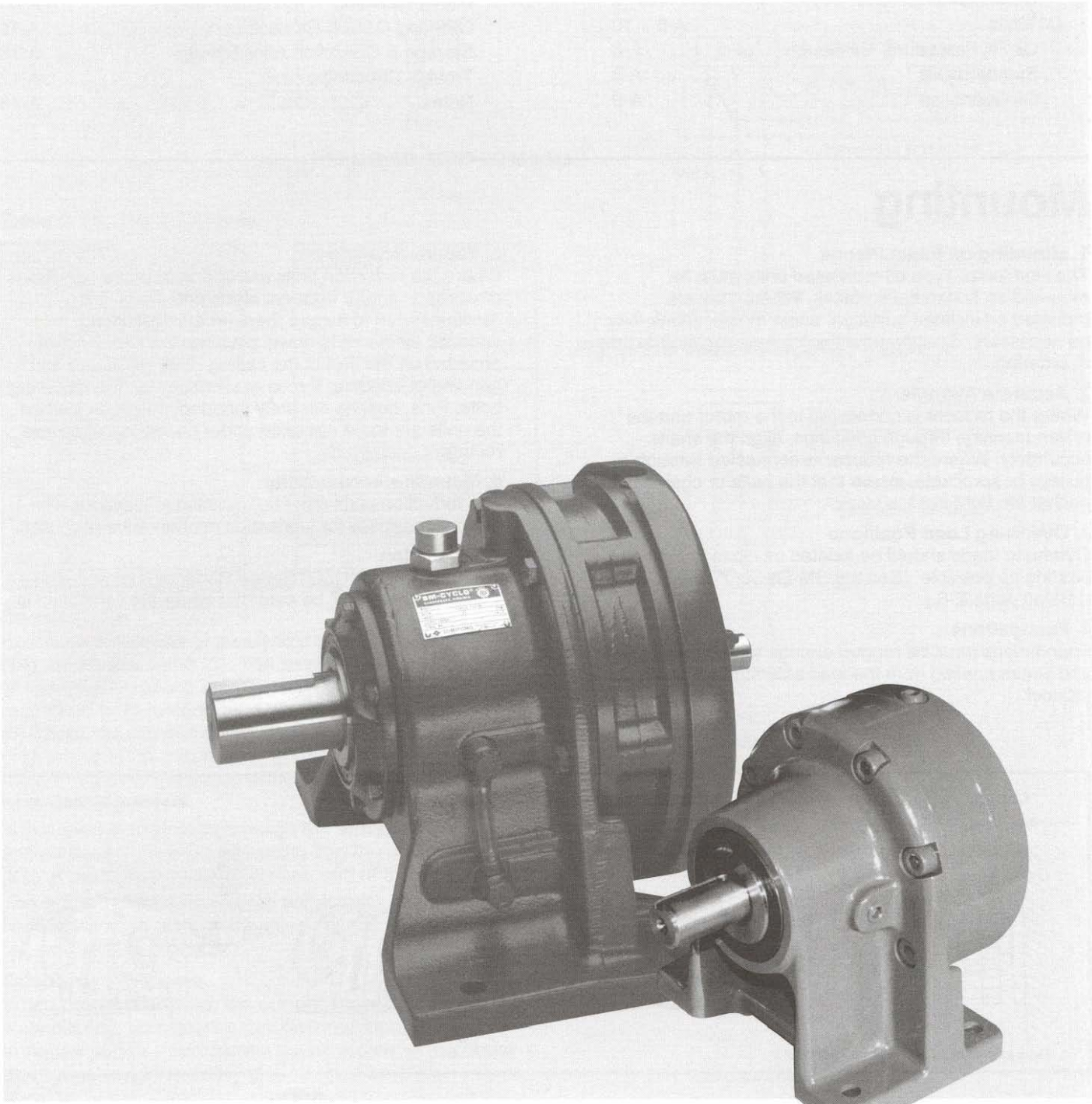
SM-CYCLO®
SPEED REDUCERS



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Mounting

1. Mounting on Exact Planes
The Horizontal Type oil-lubricated units must be mounted on horizontal surfaces. Where they are mounted on inclined surfaces, some modifications may be necessary. Specify mounting plane inclination at time of ordering.

2. Accurate Alignment
Where the reducer is connected to the motor and the driven machine through couplings, align the shafts accurately. Where the reducer is connected through V pulleys or sprockets, insure that the belts or chains are neither too tight nor too slack.

3. Overhung Load Positions
Overhung loads should be located as close to the bearing as possible. (See the SM-CYCLO® 6000 Series Catalog page E-8.)

4. Foundations
Foundations must be rugged enough to withstand shock and stress applied from the load side through the reducer.

5. Secure Housing
Where the reduction units are operated under conditions of vibration and/or frequent starts and stops, it is recommended to secure them on their mounting surfaces by inserting dowel pins into the knock-holes provided on the foot of the casing. This will insure that bending or shearing forces are reduced on the mounting bolts. Pins must be securely inserted, particularly when the units are to be operated under conditions of severe recurrent peak loads.

6. Mounting Accessibility
The reduction units must be mounted in locations with easy accessibility for lubrication maintenance purposes.

7. Ventilation
When the SM-CYCLO® Speed Reducer is mounted in a separate enclosure, be sure that adeauate ventilation is provided.

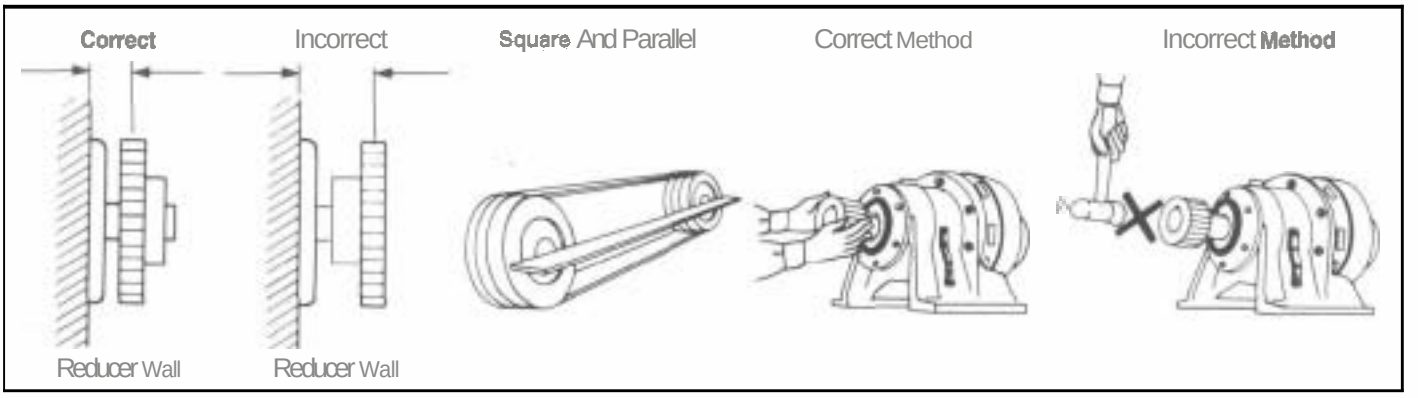


Fig. A-1 Speed Reducer − Horizontal Foot Mount, Single Reduction

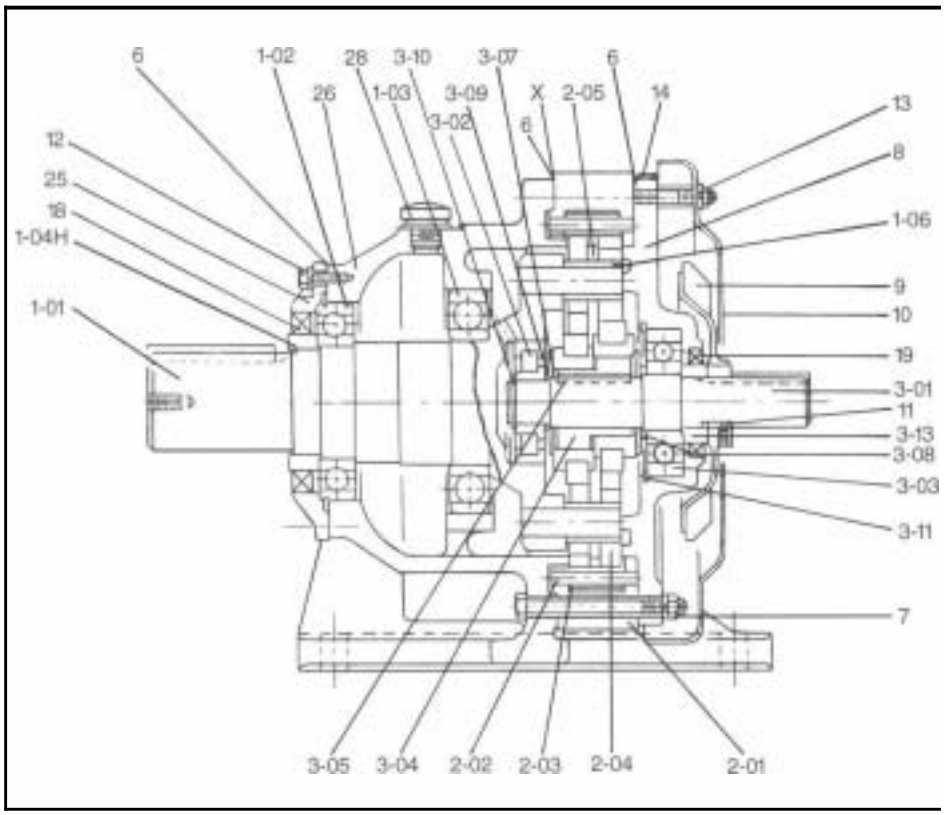
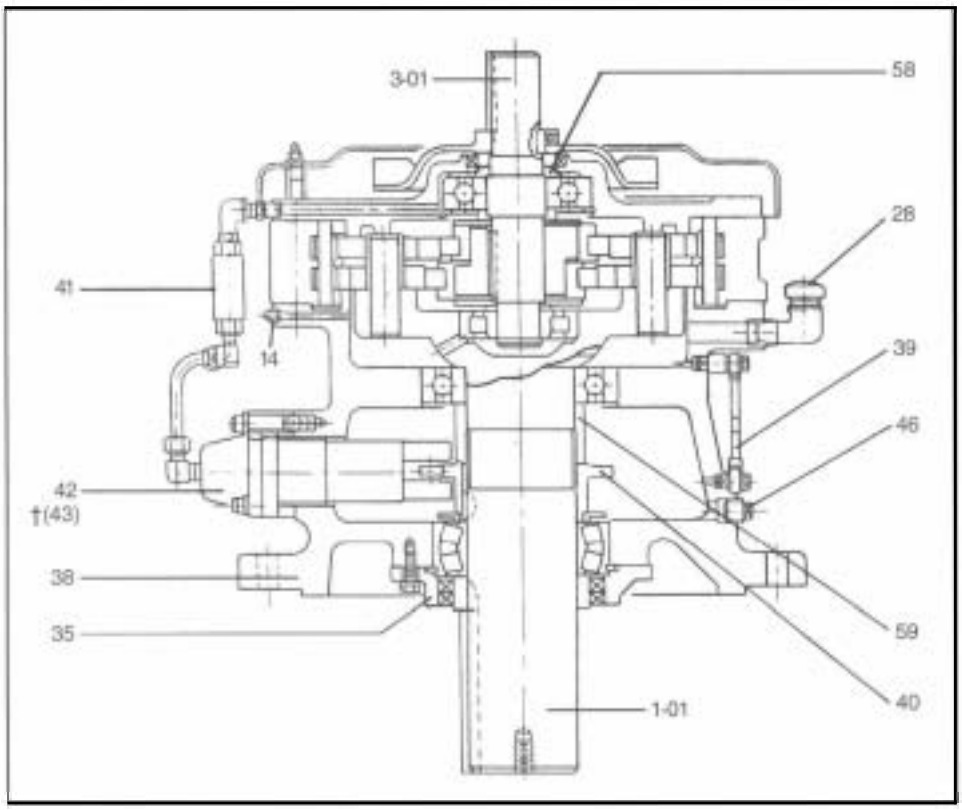


Fig. A-2 Speed Reducer − Vertical Base Mount, Single Reduction



Note: For details of oil seals, bearings or gaskets, refer to A-11 ~ **13.**
†Refer to Table **A-16** on Pg. **A-9** for units which require a positive displacement pump.
'Pt. No. **58** — frame sizes 6195-6275 only; Pt. No. **59** — frame sizes 6205-6275 only.
"See Fig. **A-3, Page **A-4;** See Fig. **A-4,** Page **A-4.**

Table A-1. Speed Reducer Main Parts

Part No.	Part Name
1-01	Slow Speed Shaft w/pins
1-02	Bearing A
1-03	Bearing B
1-04H	Oil Seal Collar—Horizontal
1-06	Slow Speed Shaft Rollers
2-01	Ring Gear Housing
2-02	Ring Gear Pins
2-03	Ring Gear Rollers
2-04	Cyclo Disc
2-05	Spacer Ring
3-01	High Speed Shaft
3-02	Bearing C
3-03	Bearing D
3-04	Eccentric Bearing Assembly
3-05	Eccentric Key
**3-06	Balance Weight
3-07	Spacer
3-08	Spacer
3-09	Spacer
3-10	Retaining Ring
3-11	Retaining Ring
3-13	Collar
† 5-01	Intermediate Shaft w/Pins
† 5-02	Bearing F
† 5-03	Bearing G
† 5-04	Eccentric Bearing Assembly
6	Gasket Set
7	Casing Nuts & Bolts
8	High Speed End Shield
9	Cooling Fan & Set Screw
10	Fan Cover
11	Fan Key
12	Bolts For SS Oil Seal Housing
13	Bolts, Spacers For Fan Cover
14	Plug
† 15	Grease Nipple
18	Slow Speed Output Oil Seal
19	High Speed Input Oil Seal
25	Horizontal Oil Seal Housing
26	Horizontal Case
28	Oil Fill Plug
29	Oil Gauge—Horizontal Unit
35	Vertical Oil Seal Housing
38	Vertical Case (Integral V Type)
39	Oil Gauge—Vertical Unit
40	Cam
41	Piping Set & Oil Signal
42	Plunger Pump
43	Positive Displacement Pump
46	Drain Plug
† 55	Intermediate Cover
† 57	Eye Bolt
*58	Oil Slinger
*59	Spacer

GENERAL CONSTRUCTION

Fig. A-3 Speed Reducer/Single Disc Type (Frame Size 6060-6095)

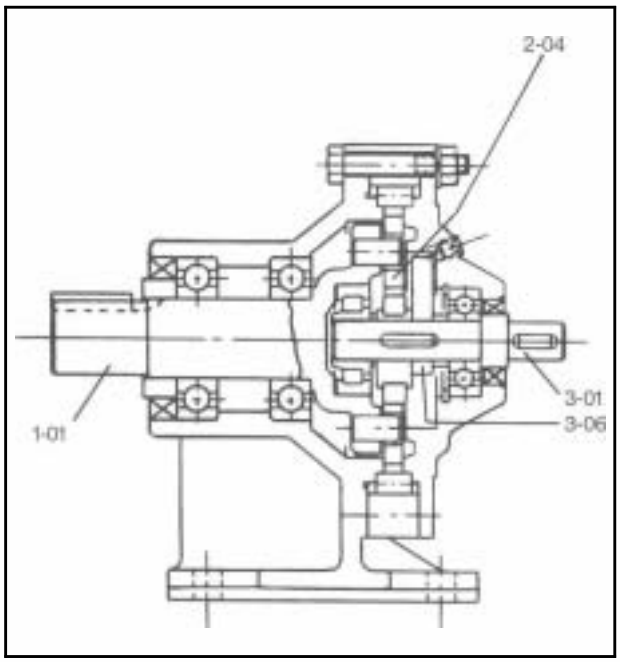
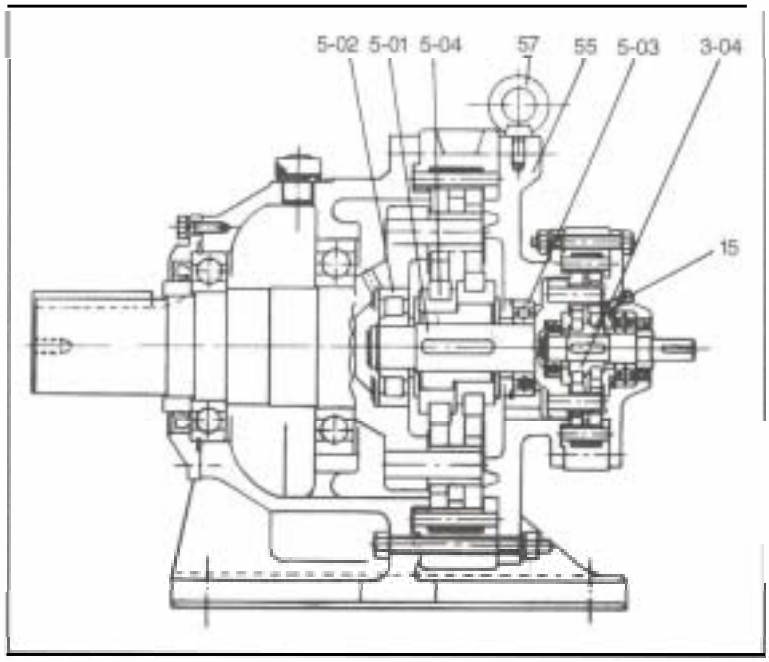


Fig. A-4 Speed Reducer/Double Reduction



Speed Reducer — Single Disc

SM-CYCLO® single reduction, Models No. 6060-6095, employ the use of a single planetary gear (Cycloid Disc) and a balance weight.

Multiple Reduction Reducers

Multiple reduction SM-CYCLO® Reducers are a combination of standard reduction mechanism assemblies connected using an intermediate shaft (Part No. 5-01) and intermediate cover (Part No. 55) between them.

Table A-2. Frame Sizes and Ratio Combination of Double Reduction Models

Frame Size Combination

Frame Size	Second Stage	First Stage
6060DA	6060	6060
6065DA	6065	6065
6070DA	6070	6065
6075DA	6075	6065
6090DA	6090	6075
6095DA	6095	6075
6100DA	6100	6075
6105DA	6105	6075
6120DA	6120	6075
6120DB	6120	6095
6125DA	6125	6075
6125DB	6125	6095
6130DA	6130	6075
6130DB	6130	6095
6130DC	6130	6105
6135DA	6135	6075
6135DB	6135	6095
6135DC	6135	6105
6140DA	6140	6075
6140DB	6140	6095
6140DC	6140	6105
6145DA	6145	6075
6145DB	6145	6095
6145DC	6145	6105
6160DA	6160	6095
6160DB	6160	6105
6160DC	6160	6125
6165DA	6165	6095
6165DB	6165	6105

Frame Size	Second Stage	First Stage
6165DC	6165	6125
6170DA	6170	6095
6170DB	6170	6105
6170DC	6170	6125
6175DA	6175	6095
6175DB	6175	6105
6175DC	6175	6125
6180DA	6180	6105
6180DB	6180	6135
6185DA	6185	6105
6185DB	6185	6135
6190DA	6190	6125
6190DB	6190	6135
6195DA	6195	6125
6195DB	6195	6135
6205DA	6205	6125
6205DB	6205	6135
6215DA	6215	6135
6215DB	6215	6165
6225DA	6225	6135
6225DB	6225	6175
6235DA	6235	6165
6235DB	6235	6185
6245DA	6245	6165
6245DB	6245	6185
6255DA	6255	6175
6255DB	6255	6195
6265DA	6265	6195
6275DA	6275	6195

Reduction Ratio Combination

Total Ratio	Second Stage Ratio	First Stage Ratio
104	13	8
121	11	11
143	13	11
165	15	11
195	15	13
231	21	11
273	21	13
319	29	11
377	29	13
473	43	11
559	43	13
649	59	11
731	43	17
841	29	29
1003	59	17
1247	43	29
1479	87	17
1849	43	43
2065	59	35
2537	59	43
3045	87	35
3481	59	59
4437	87	51
5133[1]	87	59
6177	87	71
7569	87	87

Note: [1] For frame sizes 6205DA, DB or DC ~ 6265DA, DB or DC, second stage ratio is 59 and first stage ratio is 87

LUBRICATION

Standard Type Mounted Reducer (Slow Speed Shaft Horizontal)[1,2]

Table A-3. Horizontal Mounted Single Reduction Reducers

Frame Size \ Reduction Ratio	3	5	6	8	11	23	15	17	21	25	29	35	43	51	59	71	87	119
6060 6065	Grease Lubricated (G)		Maintenance-Free Grease Lubrication (MF)															
6070 6075															59			
6080 6085																	87	
6090 6095																		
6100 6105 610H																		
6110 6115																		
6120 6125 612H																		
6130 6135	Oil Bath Lubrication (PB)																	
6140 6145 614H																		
6160 6165 616H																		
6170 6175																		
6180 6185																		
6190 6195																		
6205																		
6215																		
6225																		
6235																		
6245																		
6255																		
6265																		
6275																		

Table A-4. Horizontal Mounted Double Reduction Reducers

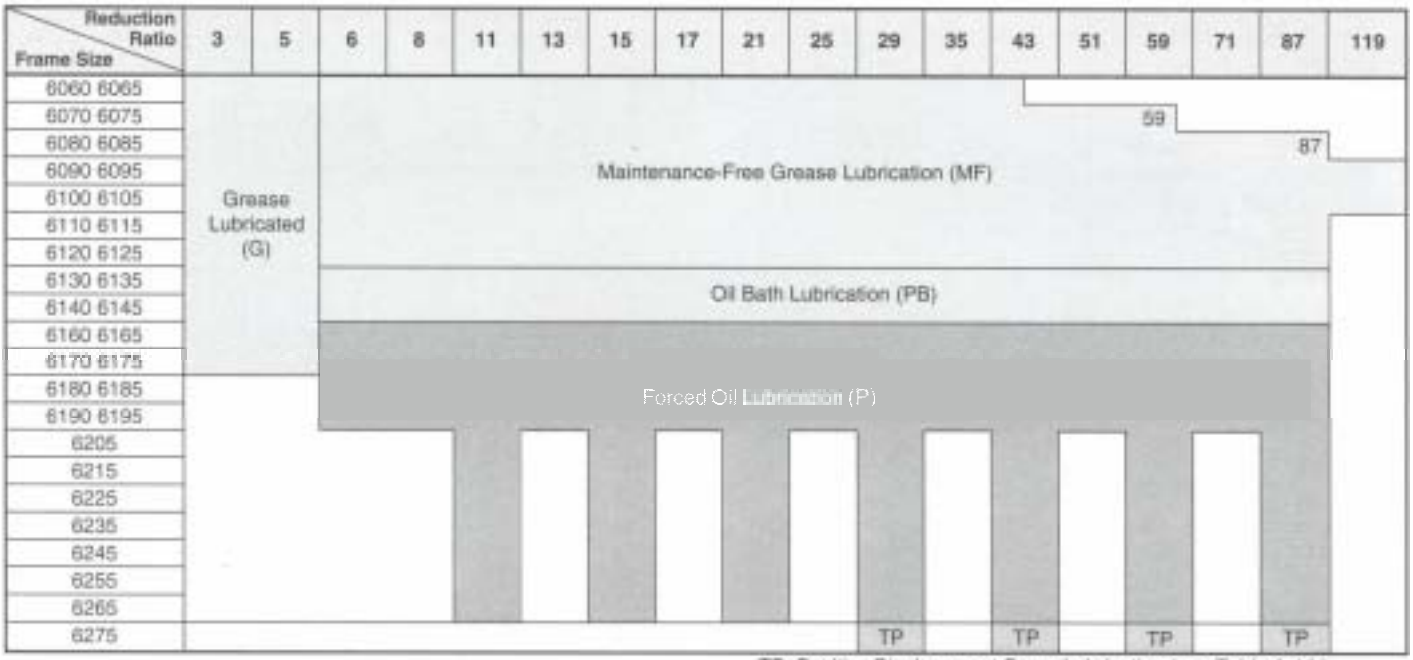
Frame Size \ Reduction Ratio	104	121	143	165	195	231	273	319	377	473	559	649	731	841	1003	1015	1247	1479	1849	2065	2537	3045	3481	4437	5133	6177	7569
6060DA 6065DA	Maintenance-Free Grease Lubrication (MF)																										
6070DA 6075DA																					2537						
6090DA 6095DA																									5133		
6100DA 6105DA																											
6120DA 6120DB																											
6125DA 6125DB																											
6130DA 6135DA	Grease Lubrication (G)																										
6130DB 6135DB																											
6130DC 6135DC																											
6140DA 6140DB 6140DC																											
6145DA 6145DB 6145DC																											
6160DA 6165DA																											
6160DB 6165DB																											
6170DA 6175DA																											
6170DB 6175DB																											
6180DA 6185DA																											
6160DC 6165DC	Oil Bath Lubrication (PB)																										
6170DC 6175DC																											
6180DB 6185DB																											
6190DA 6195DA																											
6190DB 6195DB																											
6205DA 6205DB				165																							
6215DA 6215DB		121																									
6225DA 6225DB																											
6235DA 623500																											
6245DA 6245DB																											
6255DA 6255DB																											
6265DA																											
6275DA									377																		

Notes: [1] Tables A-3 and A-4 show the standard lubrication method when tne Cyclo drive is driven at the standard input speed.
[2] Rat os shown in white in Taoles A-3 and A-4 are unavailable for the g.ven unit sues.

LUBRICATION

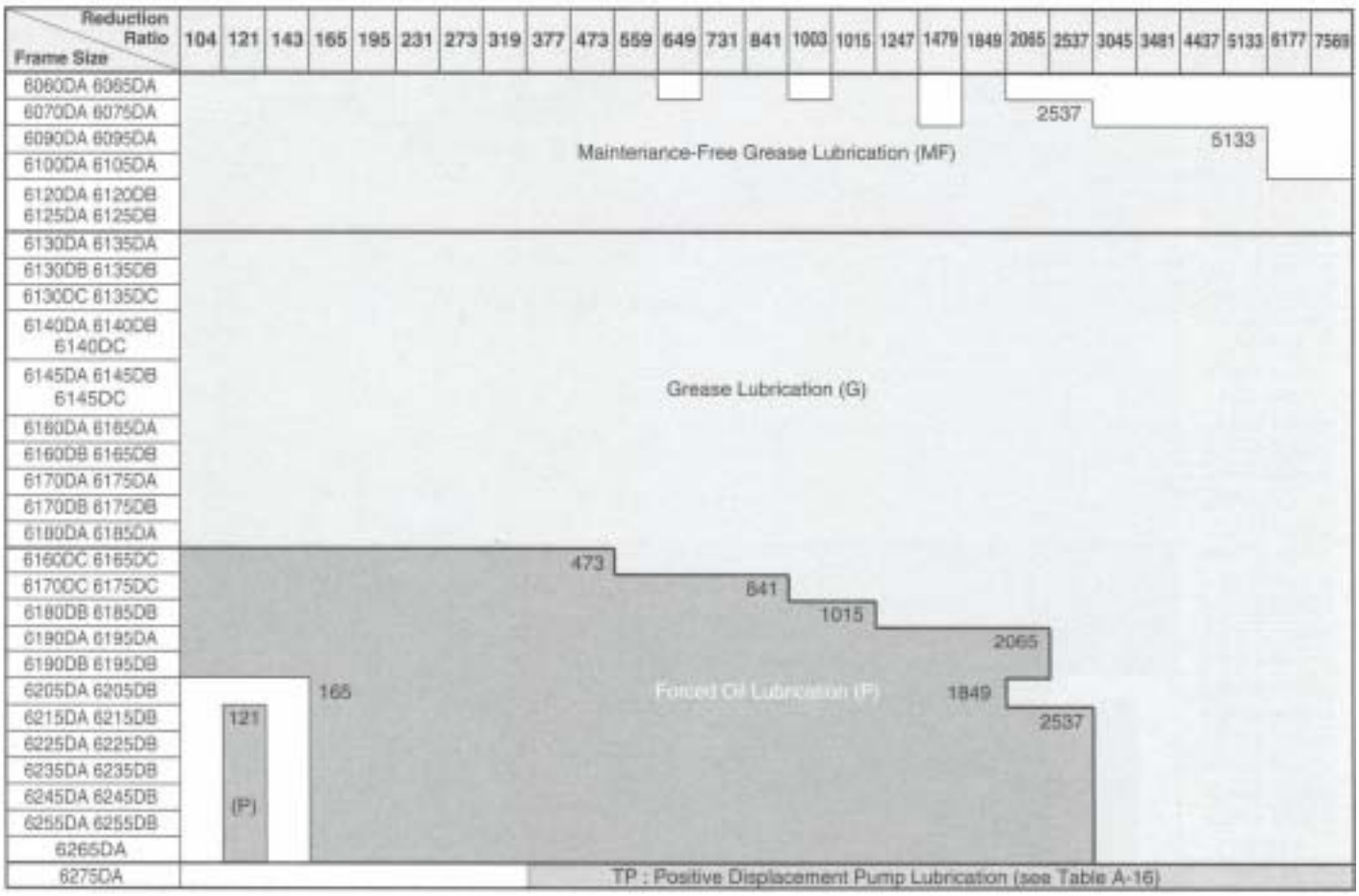
Standard Vertical Mounted Reducer (Slow Speed Shaft Vertical)[1][2][3]

Table A-5. Vertical Mounted Single Reduction Reducer



TP: Positive Displacement Pump Lubrication (see Table A-16.)

Table A-6. Vertical Mounted Double Reduction Reducer



Notes: [1] Please consult the factory for applications where the slow speed shaft is up.
[2] Tables A-5 and A-6 show the standard lubrication method when the Cyclo drive is driven at the standard input speed.
[3] Ratios shown in white in Tables A-5 and A-6 are unavailable for the given unit sizes.

Lubricants

Grease Lubricated Models

Those models listed in Tables A-3 - A-6 as grease lubricated are filled with grease before shipment to the customer and are ready for use.

Table A-7. Standard Greases[1]

Ambient Temperature[2]		SM-Cyclo® Speed Reducer
°F	°C	Shell Oil
14 to 122	-10 to 50	Shell Alvania® Grease 2 (NLGI Grade #2)

Table A-8. Grease Replenishment and Change Interval

Model	Condition		Interval[3]
Single and Double Reduction Maintenance Free Type	Replenishment		NOT REQUIRED
	Overhaul[4]		Every 20,000 Hours or Every 4 - 5 Years
Double Reduction	Replenishment	Less Than 10 Hours Per Day Operation	Every 3 - 6 Months
		10 - 24 Hours Per Day Operation	Every 500 ~ 1000
	Change	Speed Reducer Mechanism, High Speed Shaft Bearings (Speed Reducer Type)	Every 2 ~ 3 Years
		Slow Speed Shaft Bearings	Every 3 ~ 5 Years

Replenishment and Change Guidelines

Replenish grease to the reduction mechanism 1/3 to 1/2 of the quantity listed in Table A-9 or A-10 for the first reduction stage at the interval recommended in Table A-8.

When the unit is disassembled for overhauling, refill with the grease quantities indicated in Table A-9 or A-10. Or alternatively, 80% of the space around the reduction mechanism and slow speed shaft bearings of single reduction units, and 50% around the reduction mechanism of both the first and second stage of double reduction units.

Slightly larger quantities may be supplied to lower reduction ratio units, and somewhat smaller quantities for high reduction ratio units.

Apply grease liberally to the central pan (i.e., around the eccentric bearings) of the mechanism. Apply grease to both the slow speed and high speed shaft bearings as you would to ordinary bearings at the time of re-assembly.

If excessive grease is added, agitation heating of the grease will raise theoperating temperature of the unit. Avoid-excessive greasina. but do not supply an insufficient amount of grease. When the grease is insufficient, it will raise the unit's operating temperature due to breakdown of the lubrication films on the eccentric bearing. In this case, if the operating temperature rises, supply grease immediately.

Table A-9. Single Reduction Grease Quantities - oz. (g.)

Frame Size	6060 6065	6070 6075	6080 6085	6090 6095	6100 6105 610H	6110 6115	6120 6125 612H
Speed Reduction Mechanism	0.9 (25)		2.3 (65)	3.2 (90)	4.9 (140)	7.1 (200)	11.6 (330)
Slow Speed Shaft Bearing	1.2 (35)		25 (70)	3.5 (100)		3.2 (90)	4.2, (120)

Notes: [1] Avoid the use of grease other than shown in Table A7.
[2] Consult the factory when the drives are used under widely fluctuating temperatures, ambient temperatures other than those listed in Table A-7, or any other special conditions.
[3] Single reduction frame sizes 6060 ~ 612H ana double reduction frame sizes 6060DA ~ 6125DB are maintenance free units. Grease replenishment is not necessary. Where longer life of the ar ve is expected or if re- Jbricating is preferred before the recommendea interval, refer to Tables A-7, A-8, A-9 and A-10.
[4] Overhauling consists of disassembling the unit, replacing the seals and gaskets, cleaning the internal parts and then repacking the unit with designated grease.

LUBRICATION

Table **A-10.** Double Reduction Grease Quantities – **oz.** (g.)

Frame Size	6060DA 6065DA	6070DA 6075DA	6090DA 6095DA	6100DA 6105DA	6120DA 6125DA	6120DB 6125DB	6130DA 6135DA	6130DB 6135DB	6130DC 6135DC	6140DA 6145DA	6140DB 6145DB	6140DC 6145DC
Speed Reduction Mechanism (1st Stage)	0.9 (25)					3.2 (90)	0.9 (25)	3.2 (90)	4.9 (140)	0.9 (25)	3.2 (90)	4.9 (140)
Speed Reduction Mechanism (2nd Stage)	0.9 (25)		3.2 (90)	4.9 (140)	11.6 (330)		15.9 (450)					
Slow Speed Shaft Bearing (2nd Stage)	1.2 (35)		3.5 (100)		4.2 (120)		10.6 (300)					

Frame Size	6160DA 6165DA	6160DB 6165DB	6160DC 6165DC	6170DA 6175DA	6170DB 6175DB	6170DC 6175DC	6180DA 6185DA	6180DB 6185DB	6190DA 6195DA	6190DB 6195DB	6205DA	6205DB
Speed Reduction Mechanism (1st Stage)	3.2 (90)	4.9 (140)	11.6 (330)	3.2 (90)	4.9 (140)	11.6 (330)	4.9 (140)	15.9 (450)	11.6 (330)	15.9 (450)	11.6 (330)	15.9 (450)
Speed Reduction Mechanism (2nd Stage)	26.5 (750)			35.3 (1000)			38.8 (1100)		52.9 (1500)			
Slow Speed Shaft Bearing (2nd Stage)	10.6 (300)			17.6 (500)			21.2 (600)		24.7 (700)			

Frame Size	6215DA	6215DB	6225DA	6225DB	6235DA	6235DB	6245DA	6245DB	6255DA	6255DB	6265DA
Speed Reduction Mechanism (1st Stage)	15.9 (450)	26.5 (750)	15.9 (450)	35.3 (1000)	26.5 (750)	38.8 (1100)	26.5 (750)	38.8 (1100)	35.3 (1000)	52.9 (1500)	
Speed Reduction Mechanism (2nd Stage)	70.5 (2000)		88.2 (2500)		141.1 (4000)		158.7 (4500)		211.6 (6000)		282.2 (8000)
Slow Speed Shaft Bearing (2nd Stage)	28.2 (800)		31.7 (900)		35.3 (1000)		38.8 (1100)		42.3 (1200)		45.9 (1300)

Oil Lubricated Models

Oil Fill Procedure

Oil lubricated models are not filled with oil prior to shipping. Before start-up, remove the oil fill plug (See Pg. A-3, Fig. A-2, Part #28) and fill the reducer with recommended oil. Refer to Tables A-11–A-14 for standard oil, allowable viscosity, quantity, and change interval. The oil level must be to the upper red line on the oil level gauge while the unit is not operating, and above the lower red line during operation. If too much oil is supplied, the unit's operating temperature will rise due to the churning heat of the oil, or oil will leak across the high speed shaft oil seal.

Before filling a vertical base type unit with oil, remove the vent plug (Pg. A-3, Fig. A-2, Part #14). After filling, apply teflon sealing tape to threads of the vent plug before installing.

When draining oil, remove drain plug (Fig. A-5, Part #46) or lower side plug of the oil level gauge.

Oil Level Gauge

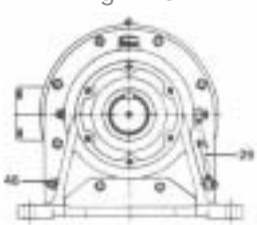
The gauge must be replaced when it becomes difficult to check the oil level due to discoloration of the vinyl hose. Use the standard vinyl oil gauge for a reducer operatin in ambient temperature –4°F to 100°F (–20°C to 40°C). &here the reducer is used at ambient temperatures greater than 100°F (40°C) or less than -4°F (–20°C), a glass gauge set or a dipstick is recommended.

The oil level gauge can be attached on either side of the casing on horizontal units. Attach on the side that is most convenient for checking the oil level. (The oil level gauge is usually attached on the right side when viewed from the slow speed shaft end.)

Table **A-11.** Standard Oils

Ambient Temperature[1,2] °F	°C	Gulf Oil	Exxon Oil	Mobil Oil	Shell Oil	BP Oil
14 to 41	-10 to 5	EP Lubricant HD 68	Spartan' EP 68	Mobilgear® 626 (ISO VG 68)	Omala® Oil 68	Energol® GR-XP 68
32 to 95	0 to 35	EP Lubricant HD 100 HD 150	Spartan' EP 100 EP 150	Mobilgear® 627,629 (ISO VG 100.150)	Omala® Oil 100, 150	Energol® GR-XP 100 GR-XP 150
86 to 122	30 to 50	EP Lubricant HD 220 HD 320 HD 460	Spartan'' EP 220 EP 320 EP 460	Mobilgear® 630,632 633,634 (ISO VG 220-460)	Omala® Oil 220, 320, 460	Energol® GR-XP 220 GR-XP 320 GR-XP 460

Fig. **A-5**



Notes: [1] Use the lower viscosity oil specified for each ambient temperature range for use in winter or relatively low ambient temperatures,
[2] Please consult the factory for consistent use in ambient temperatures other than 32°F - 104°F (0°C - 40°C).

Table A-12. Oil Fill Quantities[1]

Single Reduction					Double Reduction				
Frame Size	Mounting Configuration				Frame Size	Mounting Configuration			
	Horizontal		Vertical			Horizontal		Vertical	
	U.S. gal.	liter	U.S. gal.	liter		U.S. gal.	liter	U.S. gal.	liter
6130, 6135	0.18	0.7	0.29	1.1	6160DC, 6165DC	0.40	1.5	0.26	1.0
6140, 6145, 614H	0.18	0.7	0.29	1.1	6170DC, 6175DC	0.63	2.4	0.50	1.9
6160, 6165, 616H	0.37	1.4	0.26	1.0	6180DB, 6185DB	0.92	3.5	0.53	2.0
6170, 6175	0.50	1.9	0.50	1.9	6190DA, 6195DA	1.5	5.8	0.71	2.7
6180, 6185	0.66	2.5	0.53	2.0	6190DB, 6195DB	1.6	6.0	0.71	2.7
6190, 6195	1.1	4.0	0.71	2.7	6205DA, 6205DB	1.6	6.0	2.9	11
6205	1.5	5.5	1.5	5.7	6215DA, 6215DB	2.6	10	3.7	14
6215	2.2	8.5	2.0	7.5	6225DA, 6225DB	2.9	11	4.8	18
6225	2.6	10	2.6	10	6235DA, 6235DB	4.5	17	6.1	23
6235	4.0	15	3.2	12	6245DA, 6245DB	4.8	18	7.7	29
6245	4.2	16	4.0	15	6255DA, 6255DB	6.1	23	11.1	42
6255	5.5	21	11.1	42	6265DA	8.5	32	13.5	51
6265	7.7	29	13.5	51	6275DA	15.9	60	(15.9)	(60)
6275	14.8	56	(15.9)	(60)					

( )with trochoid pump

Table A-13. Allowable Oil Viscosity

Minimum Allowable Viscosity To Maintain Lubricating Oil Film		80 SUS During Operation
Maximum Allowable Viscosity To Allow Easy Starting	Oil Bath	20,000 SUS At Operation Start
	Forced Oil Lubrication	10,000 SUS At Operation Start

Table A-14. Oil Change Interval

Oil Change Interval		Operation Condition
Initial Oil Change	After 500 Hours of Primary Operation	Under Every Condition
Subsequent Oil Change	Every 6 Months	Less Than 10 Hours/Day Operation
	Every 2,500 Hours	10 – 24 Hours/Day Operation
	Every 1 – 3 Months	High Ambient Temperature, High Humidity or Atmosphere of Active Gas

Forced Lubrication For Vertical Units

Table A-15. Plunger Pump Type

Small Size Pump		Large Size Pump	
Frame Size	Ratio	Frame Size	Ratio
6160, 6165, 6170, 6175, 6180, 6185, 6190, 6195	See Table A-5	6205, 6215, 6225, 6235, 6245, 6255, 6265, 6275	See Table A-5
6160DC, 6165DC, 6170DC, 6175DC, 6180DB, 6185DB, 6190DA, 6195DA, 6190DB, 6195DB	See Table A-6	6205DA, 6205DB, 6215DA, 6215DB, 6225DA, 6225DB, 6235DA, 6235DB, 6245DA, 6245DB, 6255DA, 6255DB, 6265DA	See Table A-6

Plunger Pump Lubrication

The plunger pump (Fig. A-2, Part #42) is automatically operated by a cam (Fig. A-2, Part #40) fitted on the slow speed shaft (Fig. A-2, Part #I-01). The number of pumping cam teeth required is in direct relation to the reduction ratio and frame size. Please consult the factory for input speeds other than standard.

Table A-16. Positive Displacement (Trochotd) Pump Type

Cyclo Drive			Trochoid Pump[2,3]									
Type	Frame Size	Reduction Ratio	Pump Type	Pump Motor	50 Hz Zone				60 Hz Zone			
					Flow		Max. Pressure		Flow		Max. Pressure	
					gal/min	l/min	psi	kgf/cm²	gal/min	l/min	psi	kgf/cm²
Vertical Shaft	6275	29, 43, 59, 87	TOP216HA-VB3	1 HP (0.75 kW) 4P	6.3	24.0	113.8	8	7.6	28.8	71.1	5.0
	6275DA	All	TOP204HA-VB3	1/2 HP (0.4 kW) 4P	1.6	6.0	227.6	16	1.9	7.2	163.6	11.5

Positive Displacement (Trochoid) Pump Lubrication

Forced oil lubrication is accomplished by using a positive displacement pump and motor that reauires an additional electric power source. It is recommended that the main motor be interlocked with the pump motor to avoid operation without lubrication. The pump must be started 30 seconds or longer before the main motor is operated.

Notes [1] Please consult the factory for oil quantities when the reducer/gearmotor is mounted in any other position or angle
[2] Consult the factory when using an Inverter
[3] A relief valve, pressure set at 42.7 psi (3 kgf/cm²), is a standara attachment on the trochoid pump

OIL LEVEL DIMENSIONS

Foot Mount Horizontal Type
Fig. A-6

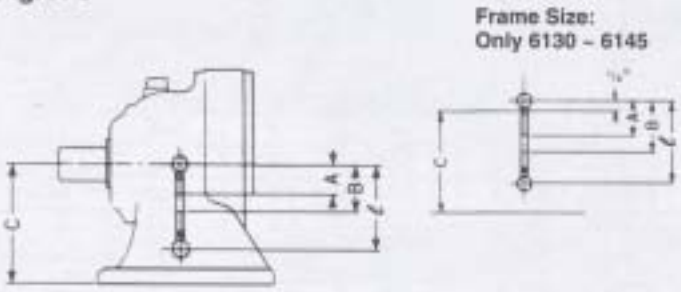
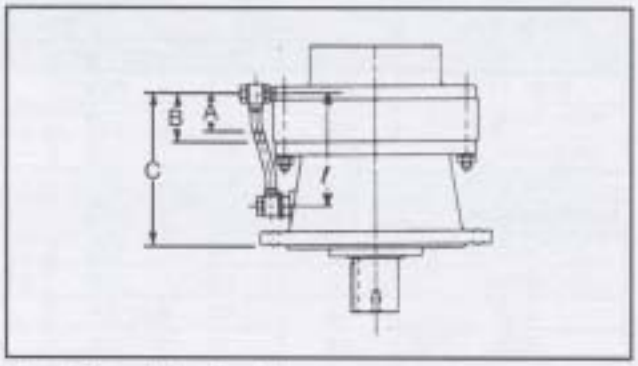


Table A-17. Oil Level Dimensions (Inches)

Frame Size	A	B	C	ℓ
6130-6135	1.38	2.17	5.91	4.65
6140, 6145, (614H)	1.38	2.17	5.91 (6.30)	4.65
6160-6165, (616H)	1.57	2.76	6.30 (7.87)	3.70
6160DC-6165DC	1.18	1.77	6.30	3.70
6170-6175	1.97	3.35	7.87	4.96
6170DC-6175DC	1.18	1.77	7.87	4.96
6180-6185	2.17	3.94	8.66	5.91
6180DB-6185DB	1.38	2.17	8.66	5.91
6190-6195	2.26	3.25	9.84	6.61
6190DA-6195DA	1.18	1.77	9.84	6.61
6190DB-6195DB	1.38	2.18	9.84	6.61
6205	2.12	3.19	9.84	6.06
6205DA	1.26	1.93	9.84	6.06
6205DB	1.26	2.13	9.84	6.06
6215	2.05	3.03	10.84	6.85
6215DA	1.18	1.97	10.43	6.85
6215DB	1.57	2.76	10.43	6.85
6225	2.25	3.43	11.03	6.85
6225DA	1.26	2.05	11.03	6.85
6225DB	1.85	3.43	11.03	6.85
6235	2.48	3.47	11.81	7.64
6235DA	1.57	2.75	11.81	7.64
6235DB	1.97	3.35	11.81	7.64
6245	2.76	3.78	13.19	8.46
6245DA	1.65	2.72	13.19	8.46
6245DB	2.00	3.35	13.19	8.46
6255	3.19	4.17	14.76	9.02
6255DA	1.97	3.35	14.76	9.02
6255DB	2.05	3.23	14.76	9.02
6265	3.23	4.21	15.75	10.16
6265DA	2.28	3.27	15.75	10.16
6275	3.35	4.53	21.26	11.22
6275DA	2.26	3.25	21.26	11.22

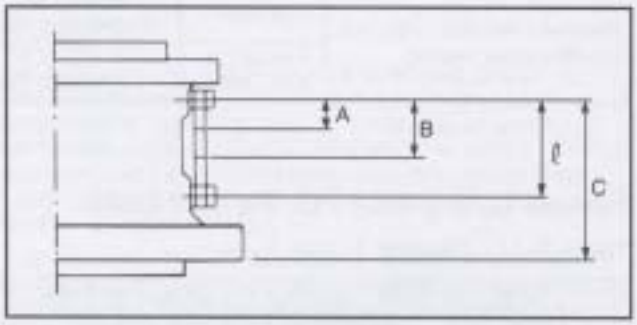
Base Mount Vertical Type
Frame Size: 6130 ~ 614H
Fig. A-7



Base Mount Vertical Type
Table A-18. Oil Level Dimensions (Inches)
Frame Size: 6130 ~ 614H

Frame Size	A	B	C	ℓ
6130-614H	1.85	2.72	7.52	5.79

Base Mount Vertical Type
Frame Size: 6160 ~ 6275
Fig. A-8



Base Mount Vertical Type
Table A-19. Oil Level Dimensions (Inches)
Frame Size: 6160 ~ 6275

Frame Size	A	B	C	ℓ
6160-6165, 616H	1.02	1.42	4.68	2.72
6170-6175	1.69	2.48	6.02	3.78
6180-6185	1.93	2.72	6.81	4.25
6190-6195	2.09	3.27	7.87	5.47
6205	1.46	2.05	7.09	3.54
6215	1.46	2.05	7.09	3.54
6225	1.46	2.05	7.87	3.54
6235	1.46	2.05	7.72	3.54
6245	1.46	2.05	7.96	3.54
*6255	4.33	4.92	19.76	6.57
*6265	4.65	5.24	21.69	7.17
6275	1.97	2.76	13.39	5.51

*Note: V6255 & V6265 Oil Gauge is on the Ring Gear Housing instead of V-Casing.

BEARINGS, OIL SEALS, GASKETS

Fig. A-9

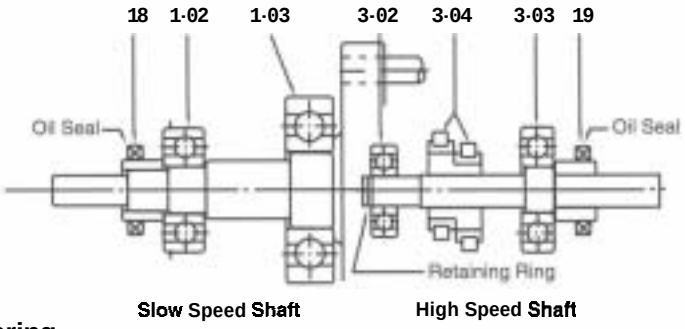


Table A-20. Slow Speed Shaft Bearing

Frame Size		Slow Speed Shaft	
Single Reduction	Double Reduction	Bearing A Part #1-02	Bearing B Part #1-03
6060, 6065	6060DA, 6065DA	6204Z	6909
6070, 6075	6070DA, 6075DA	6204Z	6909
6080, 6085	–	6305Z	6009
6090, 6095	6090DA, 6095DA	6306Z	16011
6100, 6105, 610H	6100DA, 6105DA	6306Z	16011
6110, 6115	–	6307Z	6011
6120, 6125, 612H	6120DA, 6125DA, 6120DB, 6125DB	6306Z	6013
6130, 6135	6130DA, 6135DA, 6130DB, 6135DB, 6130DC, 6135DC	6211NR	6213
6140, 6145,614H	6140DA, 6145DA, 6140DB, 6145DB, 6140DC, 6145DC	22211EXNR	6213
6160, 6165	6160DA, 6165DA, 6160DB, 6165DB, 6160DC, 6165DC	3TM-6213NR[1]	6215[1]
6170, 6175	6170DA, 6175DA, 6170DB, 6175DB, 6170DC, 6175DC	6216NR[1]	6218[1]
6180, 6185	6180DA, 6185DA, 6180DB, 6185DB	6218NR[1]	6220[1]
6190, 6195	6190DA, 6195DA, 6190DB, 6195DB	6221NR[1]	6026[1]
6205	6205DA, 6205DB	22220BNRC2	6222C2
6215	6215DA, 6215DB	23022BNRC2	6224C2
6225	6225DA,6225DB	23024BNRC2	6226C2
6235	6235DA, 6235DB	23026BNRC2	NUP228C2
6245	6245DA, 6245DB	23028BNRC2	NUP230C2
6255	6255DA, 6255DB	23032BNRC2	NUP234C2
6265	6265DA	23034BNRC2	NUP236C2
6275	6275DA	23136BNXR	6340

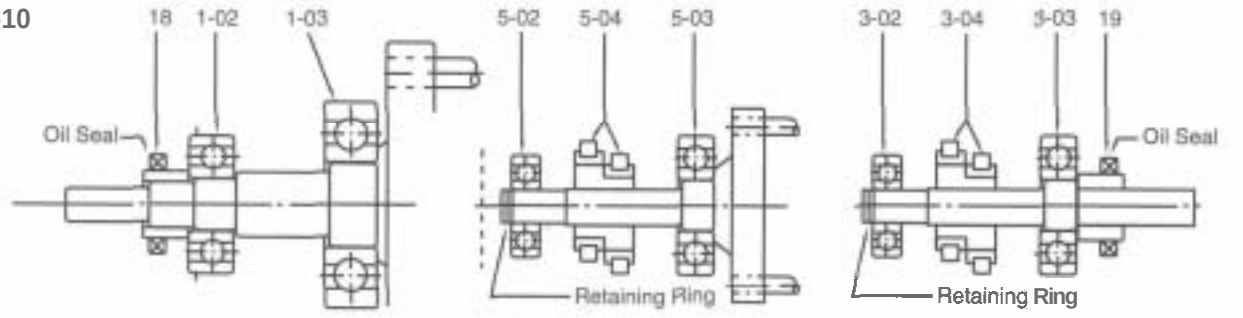
Table A-21. High Speed Shaft Bearing

Frame Size		High Speed Shaft			
Single Reduction	Double Reduction	Bearing C Part #3-02	Bearing D Part #3-03	Eccentric Part #3-04	Qty.
6060, 6065	6060DA, 6065DA, 6070DA, 6075DA	6301	6301Z	607YXX	1
6070, 6075	6090DA, 6095DA, 6100DA, 6105DA, 6120DA, 6125DA, 6130DA, 6135DA, 6140DA, 6145DA	6301	6301Z	607YXX	1
6080, 6085	–	6301SH	6302Z	6004RSH2ZZC3	1
6090, 6095	6120DB, 6125DB, 6130DB, 6135DB, 6140DB, 6145DB, 6160DA, 6165DA, 6170DA, 6175DA	6302RSH2	6302Z	Refer to Table A-22	1
6100, 6105, 610H	6130DC, 6135DC, 6140DC, 6145DC, 6160DB, 6165DB, 6170DB, 6175DB, 6180DA, 6185DA	6302RSH2	6302Z		
6110, 6115	–	6302RSH2	6302Z	611YSS, 611GSS	2
6120, 6125, 612H	6160DC, 6165DC, 6170DC, 6175DC, 6190DA, 6195DA, 6205DA	6304	6305Z	Refer to Table A-22	1
6130, 6135	6180DB, 6185DB, 6190DB, 6195DB, 6205DB, 6215DA, 6225DA	6305	6306		
6140, 6145, 614H	–	6305R	6306		
6160, 6165, 616H	6215DB, 6235DA, 6245DA	6307R	6308		
6170, 6175	6255DA, 6255DB	6408	6407	617YSX	2
6180, 6185	6235DB, 6245DB	6407	6409	618YSX	2
6190, 6195	6255DB, 6265DA, 6275DA	6408	6411	619YSX	2
6205	–	NJ310EV7	21311V1	620GXX	2
6215	–	NJ311EV16	21311V1	621GXX	2
6225	–	NJ312EV11	21312V1	622GXX	2
6235	–	NJ313EV11	21314V1	623GXX	2
6245	–	NJ314EV7	21315V1	624GXX	2
6255	–	NJ316EV1	21318V1	625GXX	2
6265	–	NJ317EV1	21318V1	626GXX	2
6275	–	NJ417	22222BL1	627GXX	2

Note: [1] For grease lubricated models, a sealed bearing should be used, which changes the following letters in the part number to those shown in bold: NR (Std.) – **ZNR;** NXR – **ZNXR;** None – add **Z**.

BEARINGS, OIL SEALS, GASKETS

Fig. A-10



Slow Speed Shaft

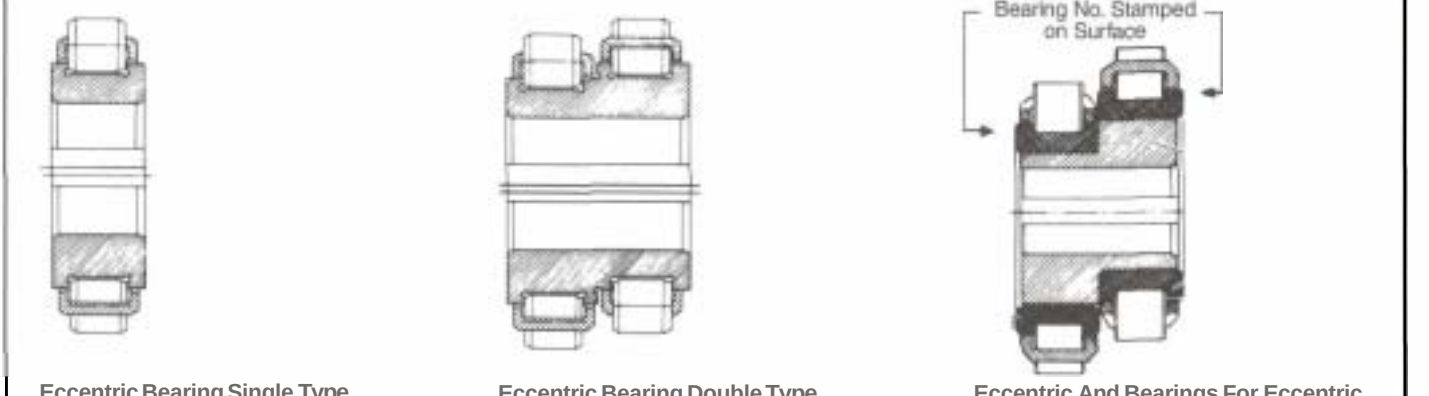
Intermediate Shaft
(For Double Reduction Units)

High Speed Shaft

Table A-22. Eccentric Bearing

	Frame Size					
High Speed Shaft, Motor Shaft Part #3-04	6090, 6095	6100, 6105	6120, 6125	6130, 6135	6140, 6145	6160, 6165
Intermediate Shaft Part #5-04 / Reduction Ratio	6090DA 6095DA	6100DA 6105DA	6120DA, 6125DA 6120DB, 6125DB	6130DA, 6135DA 6130DB, 6135DB 6130DC, 6135DC	6140DA, 6145DA 6140DB, 6145DB 6140DC, 6145DC	6160DA, 6165DA 6160DB, 6165DB 6160DC, 6165DC
6	60906YRX	6100608YRX	6120608YRX	61406-11YSX	61406-11YSX	6160608YRX2
8	60908-15YSX	6100608YRX	6120608YRX	61406-11YSX	61406-11YSX	6160608YRX2
11	60908-15YSX	61011-15YRX	6121115YSX	61406-11YSX	61406-11YSX	61611-15YSX
13	60908-15YSX	61011-15YRX	6121317YSX	61413-17YSX	61413-17YSX	61611-15YSX
15	60908-15YSX	61011-15YRX	6121115YSX	61413-17YSX	61413-17YSX	61611-15YSX
17	60917YSX	61017YSX	6121317YSX	61413-17YSX	61413-17YSX	61617-25YSX
21	60921YSX	61021YRX	61221YRX	6142125YSX	6142125YSX	61617-25YSX
25	6092529YSX	6102529YRX	6122529YSX	6142125YSX	6142125YSX	61617-25YSX
29	6092529YSX	6102529YRX	6122529YSX	6142935YSX	6142935YSX	6162935YSX
35	60935YSX	61035YRX	61235YRX	6142935YSX	6142935YSX	6162935YSX
43	60943YSX	61043YSX	61243YSX	61443-59YSX	61443-59YSX	6164351YSX
51	60951YRX	61051YRX	6125159YSX	61443-59YSX	61443-59YSX	6164351YSX
59	60959YSX	61059YRX	6125159YSX	61443-59YSX	61443-59YSX	61659YSX
71	60971YRX	61071YRX	6127187YSX	6147187YSX	6147187YSX	61671YRX2
87	60987YSX	61087YRX	6127187YSX	6147187YSX	6147187YSX	61687YSX
119	609119YSX	610119YSX	–	–	–	–

Fig. A-11



Eccentric Bearing Single Type Frame Sizes

Eccentric Bearing Double Type Frame Sizes

Eccentric And Bearings For Eccentric Frame Sizes

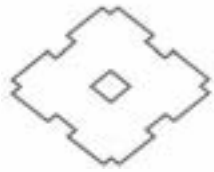


Table A-23. Intermediate Shaft Bearing

Frame Size	Intermediate Shaft				Frame Size	Intermediate Shaft			
	Bearing F Part #5-02	Bearing G Part #5-03	Eccentric Bearing Part #5-04	Qty.		Bearing F Part #5-02	Bearing G Part #5-03	Eccentric Bearing Part #5-04	Qty.
6060DA, 6065DA	6301	6909	607YXX	1	6180DA, 6185DA	6407	6208	618YSX	2
6070DA, 6075DA	6301	6909	607YXX	1	6180DB, 6185DB	6407	6213	618YSX	2
6090DA, 6095DA	6302RSH2	6007	Refer to Table A-22	1	6190DA, 6195DA	6408	6210	619YSX	2
6100DA, 6105DA	6302RSH2	6007			6190DB, 6195DB	6408	6213	619YSX	2
6120DA, 6125DA	6304	6007			6205DA	NJ310EV7	6210	620GXX	2
6120DB, 6125DB	6304	6205			6205DB	NJ310EV7	6310	620GXX	2
6130DA, 6135DA	6305	6007			6215DA, 6215DB	NJ311EV16	6311	621GXX	2
6130DB, 6135DB	6305	6206			6225DA, 6225DB	NJ312EV11	6313	622GXX	2
6130DC, 6135DC	6305	6206			6235DA, 6235DB	NJ313EV11	6314	623GXX	2
6140DA, 6145DA	6305	6007			6245DA	NJ314EV7	6315	624GXX	2
6140DB, 6145DB	6305	6206			6245DB	NJ314EV7	6316	624GXX	2
6140DC, 6145DC	6305	6206			6255DA, 6255DB	NJ316EV1	6318	625GXX	2
6160DA, 6165DA	6307R	6207			6265DA	NJ317EV1	6320	626GXX	2
6160DB, 6165DB					6275DA	NJ417	22220RH	627GXX	2
6160DC, 6165DC	6307R	6208							
6170DA, 6175DA	6406	6207	617YSX	2					
6170DB, 6175DB									
6170DC, 6175DC	6406	6208	617YSX	2					

Table A-24. Oil Seals

Frame Size	Slow Speed Shaft Part #18				High Speed Shaft Part #19		
	Type[1]	Dimension (mm)	Quantity		Type[1]	Dimension (mm)	Quantity
		(I.D. x O.D. x W)	Horizontal Shaft	Vertical Shaft		(I.D. x O.D. x W)	
6060, 6065	D	30 x 47 x 8	1	1	S	17 x 30 x 6	1
6070, 6075	D	30 x 47 x 8	1	1	S	17 x 30 x 6	1
6080, 6085	D	45 x 62 x 9	1	1	S	17 x 30 x 6	1
6090, 6095	D	50 x 72 x 12	1	1	S	20 x 35 x 7	1
6100, 6105	D	50 x 72 x 12	1	1	S	20 x 35 x 7	1
6110, 6115	D	55 x 80 x 12	1	1	S	20 x 35 x 7	1
6120, 6125	D	65 x 90 x 13	1	1	D	32 x 52 x 8	1
6130, 6135	D	68 x 88 x 12	1	2	D	38 x 58 x 11	1
6140, 6145	D	65 x 88 x 12	1	2	D	38 x 58 x 11	1
6160, 6165	D	85 x 110 x 13	1	2	D	55 x 78 x 12	1
6170, 6175	D	95 x 130 x 15	1	2	D	60 x 82 x 12	1
6180, 6185	D	110 x 145 x 15	1	2	D	65 x 88 x 12	1
6190, 6195	D	120 x 155 x 16	1	2	S	70 x 88 x 10	1
6205	D	120 x 155 x 16	1	2	S	70 x 88 x 10	1
6215	D	130 x 160 x 14	1	2	S	75 x 100 x 13	1
6225	D	145 x 175 x 14	1	2	S	75 x 100 x 13	1
6235	D	160 x 190 x 16	1	2	S	85 x 110 x 13	1
6245	D	170 x 200 x 16	1	2	S	95 x 120 x 13	1
6255	D	190 x 225 x 16	1	2	S	110 x 140 x 14	1
6265	D	200 x 240 x 20	1	2	S	110 x 140 x 14	1
6275	D	230 x 270 x 20	1	2	S	120 x 150 x 14	1

Note: [1] D indicates lip (dust proof and seal lip) type.

DISASSEMBLY/ASSEMBLY

Disassembly

SM-CYCLO® Reducers are designed to provide maximum ease when disassembing and reassembling; they require no special maintenance skills.

1. Remove the complete SM-CYCLO' Reducer with adaptor (motorized type) from the driven machine.

2. Remove the plug at the bottom of the oil gauge to drain all oil from the unit.

3. Remove the cooling fan cover and fan from those Speed Reducers (not motorized) equipped with a cooling fan, and stand the unit on a solid base with its high speed shaft side down. Remove the through bolts for the high speed end shield, ring gear housing, and lift the slow speed side, thus separating the unit into two parts so that the inner mechanism can be removed (Figs. A-12 - A17).

Note: If the reducer is motorized (C-adaptor and coupling) remove the motor and coupling before following the procedure outlined above. As a final step, remove the adaptor and cooling fan.

4. If the unit will not separate easily, gently drive a wedge at the line X shown in Fig. A-1 on page A-3 (if this produces a burr, be sure to remove it before reassembly).

5. To lift the slow speed side, attach an eyebolt to the tapped hole on the end of the slow speed shaft and use a hoist or chain block (Fig. A-12).

6. Take out the slow speed shaft rollers, item 1-06, page A-3 (Fig. A-13). Check the slow speed shaft pins (1-01) to see whether any rollers have adhered to them.

7. Using both hands, lift out the top cycioid disc (2-04) on the slow speed side (Fig. A-14).

8. Remove the spacer ring (2-05).

9. The eccentric (3-04) can be removed from the input shaft (3-01) after taking out the retaining ring (3-10) and the inner bearing raceway (Figs. A-15, A-16).

Note: In certain sizes, the eccentric bearings are roller bearings without a retainer. Remove bearings of the top disc before proceeding with the next step.

10. Take out the second disc located on the motor side. (Also remove second disc bearings and eccentric with inner bearing raceway if required.)

11. Remove the ring gear housing (2-01).

12. Follow these steps to remove the slow speed shaft (1-01) with its bearings from the casing (26): (a) Remove the horizontal oil seal housing (25). (b) With a wooden or hard rubber mallet, rap the inner end of the slow speed shaft to expose the retaining ring* from the outer raceway of the bearing. (c) Remove the retaining ring. (d) Rap the outer end of the slow speed shaft with a wooden or hard rubber mallet, and remove it from the casing.

13. The high speed shaft (3-01) with bearings is removed from the high speed shaft end shield (8) by tapping the shaft end after first taking off the retaining ring (3-11).

14. The cycloid disc is made from heat-treated bearing steel and the spacer ring is cast iron. Take care not to strike them together while handling.

The above instructions cover complete disassembly. In ordinary cases, however, only the removal of the cycloid discs and the eccentric, and removal of the slow speed shaft from the slow speed end cap is necessary.

***Note:** Retaining ring is part of bearing A (Part No. 1-02).

Assembly

SM-CYCLO® Reducers are reassembled by reversing the disassembly procedure. Care must be taken to exclude dust or foreign matter from the moving parts, and to see tnat aaskets are properly placed to make the assembly oil-tight.

Following are some helpful points to remember when assembling SM-CYCLO'' Reducers.

1. Set the ring gear housing and insert the ring gear pins and rollers; then test-rotate the pins and rollers by hand. (Apply grease liberally to the ring gear pins and rollers before they are inserted in grease lubricated SM-CYCLO® Reducers.)

2. Cycloid discs are a matched pair. Each carries the same number stamped on one side of the disc.

3. Set the cycloid disc with the stamped number face up as shown in Fig. A-17.

4. Insert the spacer (3-07) and then insert the eccentric with bearings by rapping with a wooden or hard rubber mallet (Fig. A-16).

5. Insert the other spacer and the inner bearing raceway. Secure them with the retaining ring (Fig. A-15).

6. Set the spacer ring in place.

7. Insert top disc in such a way that the mark is 180" opposed to the mark on the bottom disc (Fig. A-13).

8. Insert slow speed shaft rollers (Fig. A-13).

9. Put the slow speed shaft pins into the rollers (Fig. A-12). The above instructions are for **eccentric bearings with retainer.** Following are the instructions suggested for **roller bearings without retainer.**

a. First insert the eccentric with inner raceways of bearings by rapping with a wooden or hard rubber mallet.

Fig. A-12

Fig. A 13

Flg. A-16

Fig. A-14

Fig. A-15

Fig. A-17

on first disc.

Note: Set disc with number facing slow speed side.

b. Apply grease to the raceway of the eccentric on the disc. Fix the rollers and set disc in place.

c. Insert the spacer ring and set second disc in such a way that mark is **180'** opposed to mark on the bottom disc.

Eccentric Bearing Replacement **Precautions**

The eccentric bearings are specially designed for installation on **SM-CYCLO®** Reducers. They are special roller bearings without outer raceways **(refer** to the list of bearings on pages **A-12 ~ A-13).**

It is necessary to insert replacement bearings with numbered surfaces of the inner raceways facing outward. Note that incorrect insertion of the bearings **(i.e.,** insertion of bearings with numbered surfaces inside) causes trouble.

Disassembly and **Assembly** of **Sizes 6060-6095 SM-CYCLO®** Reducers

Small sizes **6060-6095** have a single disc system, so they differ in construction from larger sizes in the following ways:

1. A balance weight is provided in lieu of the two-disc system. Refer to figure **A-18.**

2. The balance weight must be positioned exactly **180"** as opposed to that of the eccentric.

3. There are no end plates on either side of the **eccentric.** In all other respects, 6060-6095 have exactly the same construction as the larger sizes. Follow the instructions given under "Disassembly and Assembly".

Disassembly Of Output Side (**6060-612H**)

1. With casing supported, tap output shaft until it is disengaged from casing.

2. Remove bearing **"A"** by using pulling tool.

3. Replace all bearings, gaskets and seals when reassembling. (Pages **A-11 ~ A-13).**

Assembly Of Output **Slde (6060-612H)**

1. Assemble **the "B"** bearing (Part No. **1-03)** on the slow speed shaft (Part No. **1-01).** Heating of **"B"** bearing is recommended for **easier** assembly.

Note. Do not exceed temperature of **200°F.**

2. Assemble Me casing (Part No. **26)** over the slow speed shaft (Part No. **1-01),** being sure to maintain "X" (Fig. **A-18).**

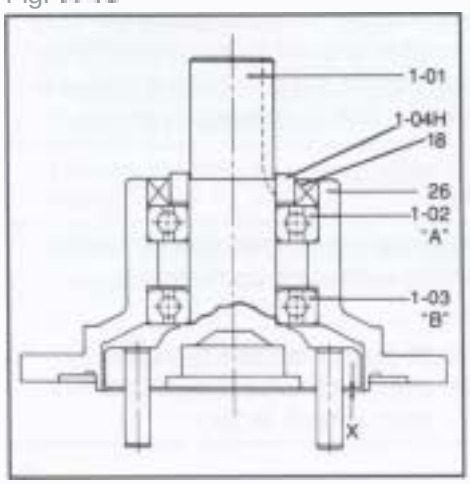
3. Carefully tap bearing **'A"** (Part No. **1-02)** onto the slow speed shaft (Part No. **1-01)** until the bearing is flush **with** the shoulder of the casing.

4. Place the collar (Part No. **1-04H)** onto the slow speed shaft **(Part** No. **1-01).** Heating Me collar is **recommended** for easier assembly.

5. Insert **the** oil seal (Part No. **18),** lip in, into the casing **(Part** No. **26).**

Note: Measure for dimension "X" preferably in 3 places to insure **proper** spacing.

Fig. **A-18**



X" Dimension (inches)

Frame Size	Dimension
6060/65	0.046 ± 0.007
6070/75 6080/85	0.042 ± 0.007
6090/95	0.046 ± 0.007
6100/05 610H	0.046 ± 0.007
6110/15/20/ 25, 612H	0.042 ± 0.007

DAILY INSPECTION

1. Visually check the oil level gauge on the vertical unit, forced-lubricated type. Check lubrication flow by viewing piping set and oil signal (Part No. 41). Faulty operation is caused by a lack of lubrication oil, damage to the plunger pump (Part No. 42) or the positive displacement pump (Part No. 43) or the clogging of pipes, etc. In case of faulty operation, stop and inspect the unit immediately.

2. A temperature rise of approximately 105°F (40.6°C) above ambient on the surface of the ring gear housing (Part No. 2-01) is allowable if the temperature fluctuation is small. If temperature rises rapidly from a stable condition, add the recommended oil or grease (Tables A-7 and A-11). A rapid temperature rise may be caused from a lack of lubrication.

If after lubricating unit, the problem persists, stop operation and consult factory.

3. When an abnormal sound is heard from inside the unit, stop operation and inspect the unit.

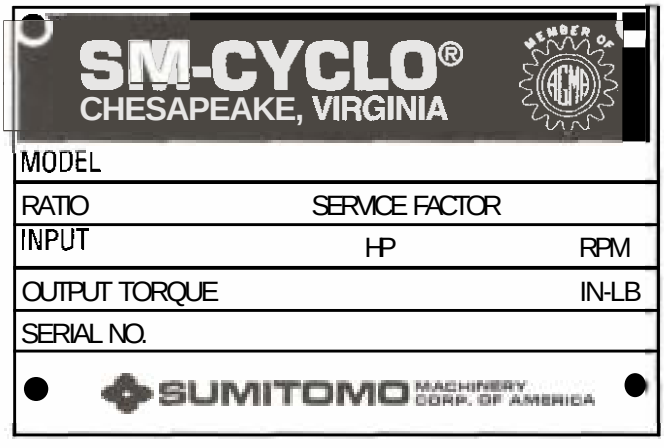
4. If the lubrication oil leaks, replace the damaged or worn part with a new one. (Refer to Part No. 1-04H, Page A-3.)

Ordering Correct Replacement Units Or Parts

The SM-CYCLO® is fully standardized to offer maximum part interchangeability among models of the same frame size. However, there are many frame sizes, models and types in the production range of SM-CYCLO? Therefore to get correct replacement units or parts, proper information to identify the speed reducer in auestion is essential. The name plate, which is secured'to the body of the drive, provides this identifying data.

Please give the full description shown on the name plate to your distributor. Be sure to include the *SERIAL* NUMBER and MODEL NUMBER. This information, along with our production records, will enable us to provide you with the correct replacement unit or parts.

Name Plate on SM-CYCLO®



Storage And Operation After Storage

Storage 6 Months–1 Year

Oil-Lubricated

1. Completely fill unit(s) with a rust-preventive oil (NP20 or equivalent) or a circulating oil (Shell VSI No. 100 or equivalent).

2. At approximately 3 month intervals, rotate the input shaft a sufficient number of times to insure all internal components remain coated. (The higher the ratio, the greater the amount of rotations needed for proper lubrication.)

Grease-Lubricated

Grease-lubricated models do not require any special attention during storage. (Inspect unit before operation.)

Note: For both the Oil-Lubricatedand *Grease-*Lubricatedmodels, if units are to be stored for a period exceeding 1 year, consult factory.

Operation After Storage 6 Months–1 Year

Oil-Lubricated

1. Completely drain the rust preventive, or circulating oil from unit.

2. Flush unit with the recommended operating oil as shown in Table A-11.

3. After flushing, fill the unit to the proper oil level with the recommended lubricating oil.

Grease-Lubricated

Add ½ of the recommended quantity of new grease as shown in Table A-10.

Note: Consult the factory before operating units stored for periods greater than 1 year.

TROUBLESHOOTING AND REPAIR

This troubleshooting guide is to help you identify and overcome common problems of reducers. If you have a problem not listed below, please consult factory.

PROBLEM WITH THE REDUCER		POSSIBLE CAUSES	SUGGESTED REMEDY
Runs Hot	Overloading	Load exceeds the capacity of the reducer.	Check rated capacity of reducer, replace with unit of sufficient capacity or reduce load.
	Improper Lubrication	Insufficient lubrication.	Check lubricant level and adjust up to recommended levels.
		Excessive lubrication.	Check lubricant level and adjust down to recommended level.
		Wrong lubricant.	Flush out and refill with correct lubricant as recommended.
Runs Noisy	Loose Foundation Bolts	Weak mounting structure.	Inspect mounting of reducer. Tighten loose bolts and/or reinforce mounting and structure.
		Loose hold down bolts.	Tighten bolts.
	Worn Disc	Overloading unit may result in damage to disc.	Disassemble and replace disc. Recheck rated capacity of reducer.
	Failure of Bearings	May be due to lack of lubricant.	Replace bearing. Clean and flush reducer and fill with recommended lubricant.
		Overload.	Check rated capacity of reducer, replace with unit of sufficient capacity or reduce load.
	Insufficient Lubricant	Level of lubricant in the reducer not properly maintained.	Check lubricant level and adjust to factory-recommended level.
	Damaged Pins & Rollers	Overloading of reducer.	Disassemble and replace ring gear pins and rollers. Check load on reducer.
Output Shaft Does Not Turn	Input Shaft Broken	Overloading of reducer can cause damage.	Replace broken shaft. Check rated capacity of reducer.
		Key missing or sheared off on input shaft.	Replace key.
	Eccentric Bearing Broken	Lack of lubricant.	Replace eccentric bearing. Flush and refill with recommended lubricant.
		Coupling loose or disconnected.	Properly align reducer and coupling. Tighten coupling.
Oil Leakage	Worn Seals	Caused by dirt or grit entering seal.	Replace seals. Breather filter may be clogged. Replace or clean filter.
		Overfilled reducer.	Check lubricant level and adjust to recommended level.
		Vent clogged.	Clean or replace element, being sure to prevent any dirt from falling into the reducer.
		Improper mounting position, such as wall or ceiling mount of horizontal reducer.	Mount horizontally or rework reducer to wall or ceiling mount.

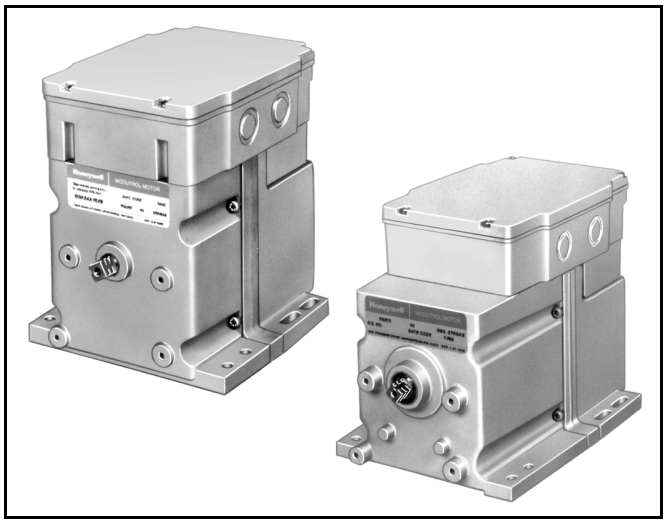
VI

COMPONENT MANUALS MODUTROL MOTOR

Honeywell

Series 72
Modutrol IV™ Motors

PRODUCT DATA



APPLICATION

The Series 72 Modutrol IV Motors are used to control dampers and valves. The motors accept a current or voltage signal from an electronic controller to position a damper or valve at any point between open and closed.

FEATURES

- **Replaces M744S,T,Y and M745S,T,Y Motors.**
- **M7261, M7274, M7281, M7284, and M7294 are non-spring return motors; M7272, M7282, M7285, and M7286 are spring return motors.**
- **Oil immersed motor and gear train for reliable performance and long life.**
- **Wiring box provides NEMA 3 weather protection.**
- **Actuator motor and circuitry operate from 24 Vac. Models available with factory installed transformer or an internal transformer can be field added.**
- **Quick connect terminals standard—screw terminal adapter available.**
- **Adapter bracket for matching shaft height of older motors is standard with replacement motors.**
- **Nominal timing of 30 seconds for 90° stroke and 60 seconds for 160° stroke.**
- **Valve and damper linkages, explosion-proof housing, and auxiliary switches available as accessories.**
- **Spring return motors are rated for 25 lb.-in. and 60 lb.-in torque.**
- **Non-spring return motors are rated for 35 lb.-in., 75 lb.-in., 150 lb.-in., and 300 lb.-in. torque.**
- **Models available with adjustable start (zero) and span.**
- **Models available with 4 to 20 mA input signal.**
- **Models available with 2 to 10 Vdc input signal.**
- **Die-cast aluminum housing.**

Contents

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Features 1
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Ordering Information 2
Installation 5
Settings and Adjustments 10
Operation and Checkout 12

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63-2202-4

SPECIFICATIONS

Models: TRADELINE models are selected and packaged to provide ease of stocking, ease of handling and maximum replacement value. TRADELINE model specifications are the same as those of standard models unless specified otherwise. TRADELINE models have auxiliary switch cams.

NOTE: Auxiliary switches can only be added to motors that include auxiliary switch cams. (These cams cannot be field-added.)

IMPORTANT

The specifications given in this publication do not include normal manufacturing tolerances. Therefore, an individual unit may not exactly match the listed specifications. Also, this product is tested and calibrated under closely controlled conditions and some minor differences in performance can be expected if those conditions are changed.

Modutrol IV Order Number Guide: See Table 1.

Dimensions: See Fig. 1.

Table 1. Modutrol IV Order Number Guide.

M	Motor							
	72	4-20 mA or 2-10 Vdc Control[a]						
		6	—		35 lb-in. Non-Spring Return			
		7	25 lb-in. Spring Return		75 lb-in. Non-Spring Return			
		8	60 lb-in. Spring Return		150 lb-in. Non-Spring Return			
		9	—		300 lb-in. Non-Spring Return			
			1	Single-ended shaft		Non-Spring Return		
			2			Normally Closed[b] Spring Return		
			4	Dual-ended shaft		Non-Spring Return		
			5			Normally Closed[b] Spring Return		
			6			Normally Open[c] Spring Return		
				A	0 Auxiliary Switches	Fixed Stroke	Normally Closed[b]	
				B	1 Auxiliary Switch			
				C	2 Auxiliary Switches			
				D	0 Auxiliary Switch	Adjustable Stroke		
				F	2 Auxiliary Switches			
				G	0 Auxiliary Switch	Fixed Stroke	Normally Open[c]	
				L	1 Auxiliary Switch	Adjustable Stroke		
				Q	2 Auxiliary Switches	Fixed Stroke	Normally Closed[b]	
M	**61**	**8**	**4**	**A**	**XXXX**	See Catalog for Complete O.S. Number		

[a] Adjustable zero and span.

[b] Electrically normally closed. Shaft rotates clockwise (viewed from the power end) with increase in control signal. Motor drives to normally closed position when powered with control wiring not connected.

[c] Electrically normally open. Shaft rotates counterclockwise (viewed from the power end) with increase in control signal. Motor drives to normally open position when powered with control wiring not connected.

ORDERING INFORMATION

When purchasing replacement and modernization products from your TRADELINE® wholesaler or distributor, refer to the TRADELINE® Catalog or price sheets for complete ordering number.

If you have additional questions, need further information, or would like to comment on our products or services, please write or phone:

1. Your local Home and Building Control Sales Office (check white pages of your phone directory).
2. Home and Building Control Customer Relations
   Honeywell, 1885 Douglas Drive North
   Minneapolis, Minnesota 55422-4386

In Canada—Honeywell Limited/Honeywell Limitée, 35 Dynamic Drive, Scarborough, Ontario M1V 4Z9.
International Sales and Service Offices in all principal cities of the world. Manufacturing in Australia, Canada, Finland, France, Germany, Japan, Mexico, Netherlands, Spain, Taiwan, United Kingdom, U.S.A.

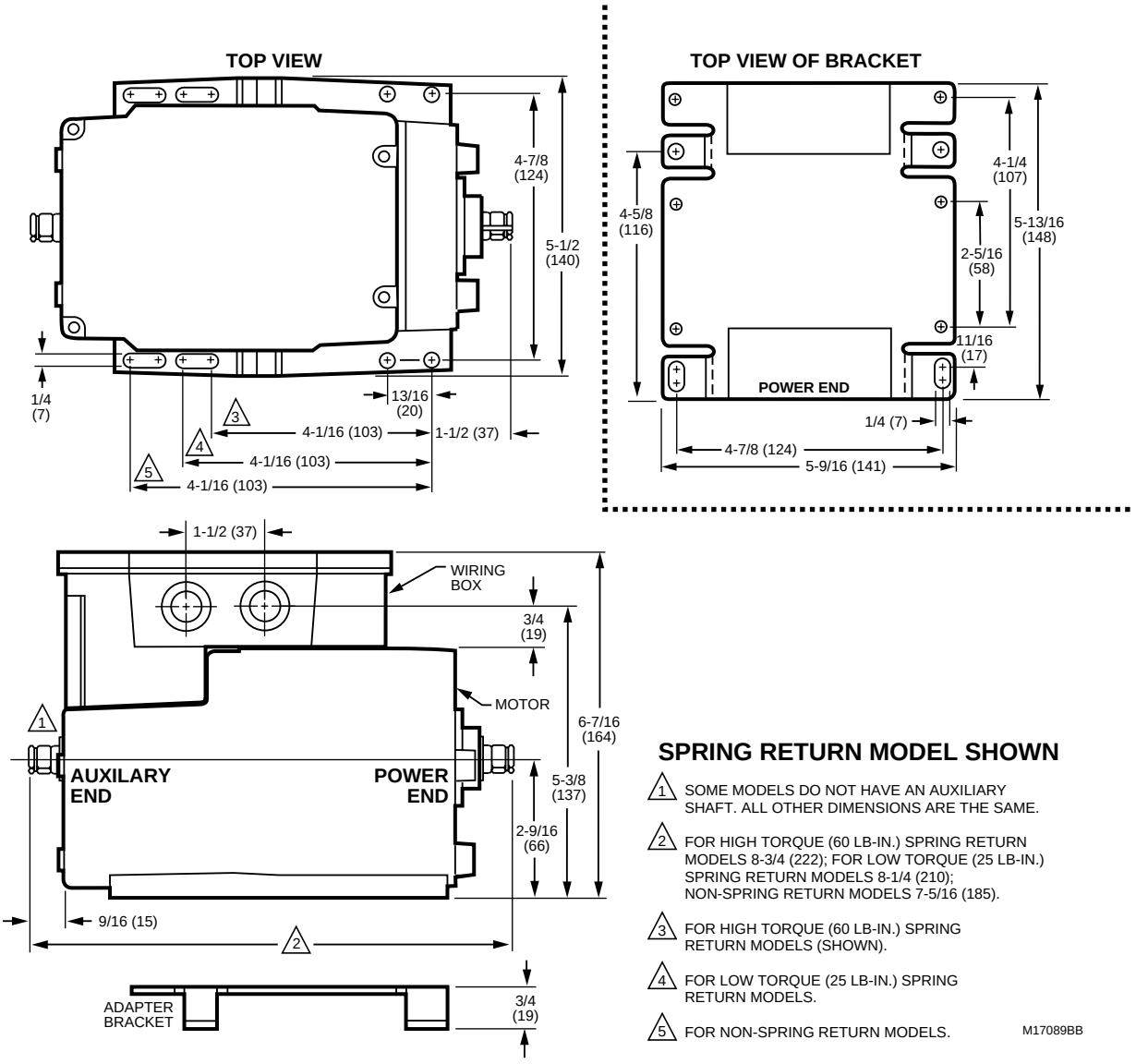


Fig. 1. Series 72 Modutrol IV Motor dimensions in in. (mm).

Controller: These motors can be used with any electronic controller that provides a stable noise-free proportional current output as specified in Electrical Ratings, Input Range below.

Electrical Ratings:

Power Consumption: See Table 2.

Input Range:

- Current, Nonadjustable: 4 to 20 mA nominal, 25 mA maximum.
- Current, Adjustable: 4 to 20 mA adjustable, 50 mA maximum.
- Zero/Null (Motor Closed): 0.08 to 18 mA.
- Span: 1.8 to 18 mA.
- Voltage, Nonadjustable: 2 to 10 Vdc.

Input Impedance:

- 4 to 20 mA Input: 100 ohms.
- 2 to 10 Vdc Input: 400K ohms.

Table 2. Series 72 Modutrol IV Motor Power Consumption Ratings (at 120 Vac, 50/60 Hz).

Model	Power Consumption	
	Watts	Amps
M7261	19	0.20
M7272	26	0.26
M7274	15	0.71
M7281	23	0.24
M7282	28	0.28
M7284	23	0.24
M7285	28	0.28
M7286	23	1.00
M7294	23	0.24

Auxiliary Switch Ratings (in Amps): See Table 3.

Table 3. Auxiliary Switch Ratings (in Amps).

One Contact Rating[a]	120V	240V
Full Load	7.2	3.6
Locked Rotor	43.2	21.6

[a] 40 VA pilot duty, 120/240 Vac on opposite contact.

Stroke: Fixed 90° or 160° models available. Other models available with field adjustable strokes from 90° to 160°. Stroke adjusted by means of cams located in the wiring compartment.

Timing: Nominal 30 seconds for 90° stroke and 60 seconds for 160° stroke.

Dead Weight Load On Shaft: 200 lb (91 kg) on motor power or auxiliary end; maximum combined load of 300 lb (136 kg).

Motor Rotation:
Closed: Counterclockwise rotation limit as viewed from motor power end.
Open: Clockwise rotation limit as viewed from motor power end.
Mechanically Normally Closed: Spring return. Normally closed motors rotate to closed position on power loss.
Mechanically Normally Open: Spring return. Normally open motors rotate to open position on power loss.
Electrically Normally Closed: Both spring return and non-spring motors return to closed position on minimum signal.
Electrically Normally Open: Both spring return and non-spring return motors return to open position on minimum signal.

Ambient Temperature Ratings: -40 to 150°F (-40 to 66°C).

Shaft: 3/8 in. [9.5 mm] square.

Approvals:
Underwriters Laboratories Inc. Listed: File No. E4436; Guide No. XAPX.
Canadian Standards Association Certified: General listed File No. LR1620; Guide No. 400-E.

Accessories:
198162AA Internal Transformer 120/208/240 Vac 50/60 Hz primary, 24 Vac secondary.
198162EA Internal Transformer; 120 Vac 50/60 Hz primary, 24 Vac secondary.
198162GA Internal Transformer; 220 Vac 50/60 Hz primary, 24 Vac secondary.
198162JA Internal Transformer; 24 Vac 50/60 Hz primary, 24 Vac secondary (for electrical isolation).
220736A Internal Auxiliary Switch Kit; one switch, can be field-installed on TRADELINE models.
220736B Internal Auxiliary Switch Kit; two switches, can be field-installed on TRADELINE models.
220738A Adapter Bracket raises motor shaft height by 19 mm to match that of previous Modutrol® Motor models.
220741A Screw Terminal Adapter converts the standard quick-connect terminals to screw terminals.
221455A Infinitely Adjustable Crank Arm, can rotate through downward position and clear motor base without requiring an adapter bracket.
4074ERU Weatherproofing Kit provides NEMA 3 rating for Modutrol IV Motors mounted in position other than upright.
4074EZE Bag Assembly with parts that can provide CE compliance.
7617ADW Crank Arm, can rotate through downward position and clear motor base without requiring an adapter bracket.
ES650-117 Explosion-Proof Housing encloses motor for use in explosive atmospheres. Not for use with Q5001 (or any other valve linkages). Order separately from O-Z/Gedney Inc. To order, contact: O-Z/Gedney, Nelson Enclosures and Controls,
(918) 641-7381 or (918) 641-7374; or write to:
O-Z/Gedney, Nelson Enclosures and Controls
P.O. Box 471650
Tulsa, OK 74147-1650
(Requires Honeywell 7617DM Coupling.)
Q100 Linkage connects Modutrol® Motor to V51 Butterfly Valve. Requires the 220738A Adapter Bracket.
Q181 Auxiliary Potentiometer for sequence or unison control of 1 to 4 additional modulating (Series 90) motors.
Q5001 Bracket and Linkage Assembly connects Modutrol IV Motor to water or steam valve.
Q605 Damper Linkage connects motor to damper. Includes motor crank arm.
Q607 External Auxiliary Switch controls auxiliary equipment as a function of motor position.

INSTALLATION

When Installing this Product...

1. Read these instructions carefully. Failure to follow them could damage the product or cause a hazardous condition.
2. Check the ratings given in the instructions and on the product to make sure the product is suitable for your application.
3. Installer must be a trained, experienced service technician.
4. After installation is complete, check out product operation as provided in these instructions.

CAUTION

Electrical Shock or Equipment Damage Hazard. Can shock individuals or short equipment circuitry.

Disconnect all power supplies before installation. Motors with auxiliary switches can have more than one disconnect.

CAUTION

Equipment Damage Hazard.
Can damage the motor beyond repair.

Never turn the motor shaft by hand or with a wrench. Forcibly turning the motor shaft damages the gear train and stroke limit contacts.

IMPORTANT

Always conduct a thorough checkout when installation is complete.

Location

Allow enough clearance for accessory installation and motor servicing when selecting a location (see Fig. 1). If located outdoors, use liquid-tight conduit connectors with the junction box to provide NEMA 3 weather protection. If mounted outdoors in a position other than upright, install a 4074ERU Weatherproofing Kit and liquid-tight connectors to provide NEMA 3 protection.

CAUTION

Motor Damage Hazard.
Deteriorating vapors and acid fumes can damage metal parts.

Install motor in areas free of acid fumes and other deteriorating vapors.

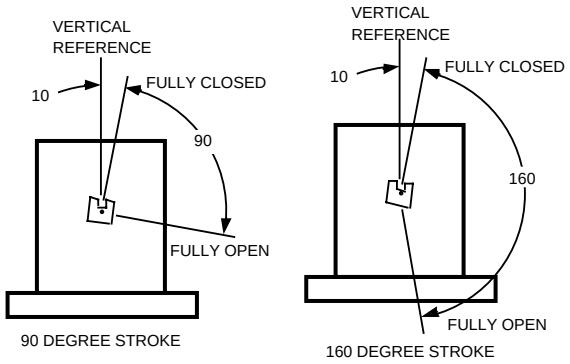
In excessive salt environments, mounting base and screws should be zinc or cadmium plated, not stainless steel or brass. Use the 220738A Adapter Bracket for mounting on these surfaces.

Mounting

Use the following guidelines for proper motor mounting:

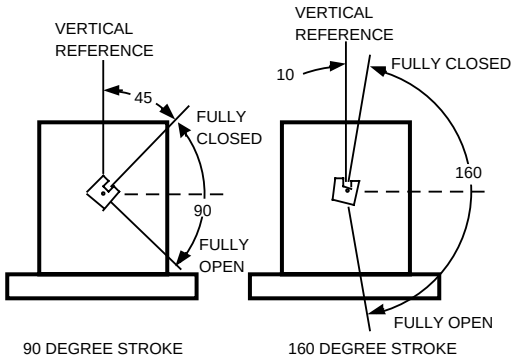
- Always install motors with the crankshaft horizontal.
- Mounting flanges extending from motor housing base are drilled for 1/4 inch (6.4 mm) machine screws or bolts.
- Non-Spring Return Motors are shipped from the factory in the closed position (at the counterclockwise rotation limit, as viewed from the motor power end).
- Spring Return Motors are shipped from the factory in their normal position.
- Normally closed models are shipped at the counterclockwise rotation limit, as viewed from the motor power end.
- Normally open models are shipped at the clockwise rotation limit, as viewed from the motor power end.

M7272, M7282, M7285, M7286



SPRING RETURN MOTORS

M7261, M7274, M7281, M7284, M7294



NON-SPRING RETURN MOTORS

M5509

Fig. 2. Motor shaft position at limit of rotation (viewed from motor power end).

Adapter Bracket

The 220738A Adapter Bracket, positioned between the motor and the equipment, raises motor shaft height by 0.75 in. (19 mm) to match that of previous Modutrol® Motor models.

The following applications require this bracket:
- Q607 External Auxiliary Switch.
- Damper linkage applications requiring added clearance to allow:
  - — Crank arm rotation through the downward position.
  - — Sufficient damper linkage to reach the motor shaft.
- All valve linkages except the Q5001.

NOTE: When the bracket is not used in a replacement application, the damper linkage requires adjustment for the new shaft position.

To mount the motor with the bracket:
1. Mount the bracket to the equipment with existing or standard bolts.
2. Using the provided bolts, mount the motor to the bracket threaded holes. See Fig. 3.

For valve linkage applications (other than the Q5001):
1. Mount the bracket to the linkage.
2. Position the motor on the bracket to align the motor shaft with the linkage.
3. Attach the motor to the bracket with the four bolts provided. See Fig. 4.

Damper Linkages

The motor does not include a crank arm. Order the crank arm separately (see Accessories in the Specifications section). For detailed instructions on the assembly of specific linkages, refer to the Installation Instructions packed with the linkage.

⚠ CAUTION

Equipment Damage Hazard.
Stalling a motor can damage the drive shaft.
Ensure installation of motors and linkages allows the motor to drive through full stroke without obstruction.

Valve Linkages

The Q100 Linkage requires a 220738A Adapter Bracket for all valve applications. Applications with the Q5001 Valve Linkage do not require the 220738A Adapter Bracket (see Fig. 4).

For detailed instructions on specific linkage assemblies, refer to the instruction sheet packed with the linkage. In general, check the following points when installing a motor and linkage:
- Adjust valve and louver-type damper linkages so the damper or valve moves through only the maximum required distance while the motor moves through its full stroke.
- With modulating control, maximum damper opening should be no more than 60 degrees. Little additional airflow is provided beyond this point.
- Do not exceed load and torque ratings in any application.

Junction Box

When used with liquid-tight conduit connectors, the junction box provides NEMA 3 weather protection for the motor. The junction box, standard with replacement motors, encloses the terminals and provides knockouts for wiring conduits. Housing an internal transformer or internal auxiliary switches requires using a junction box.

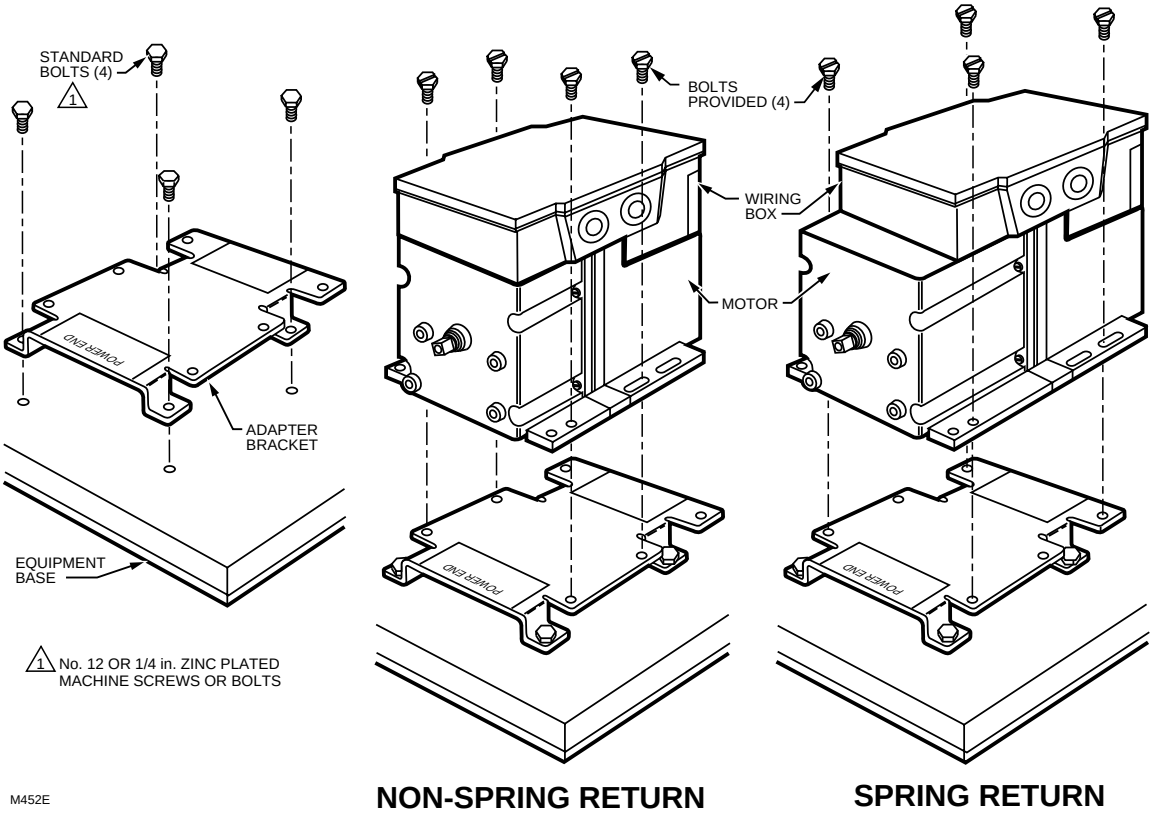


Fig. 3. Mounting the motor with an adapter bracket.

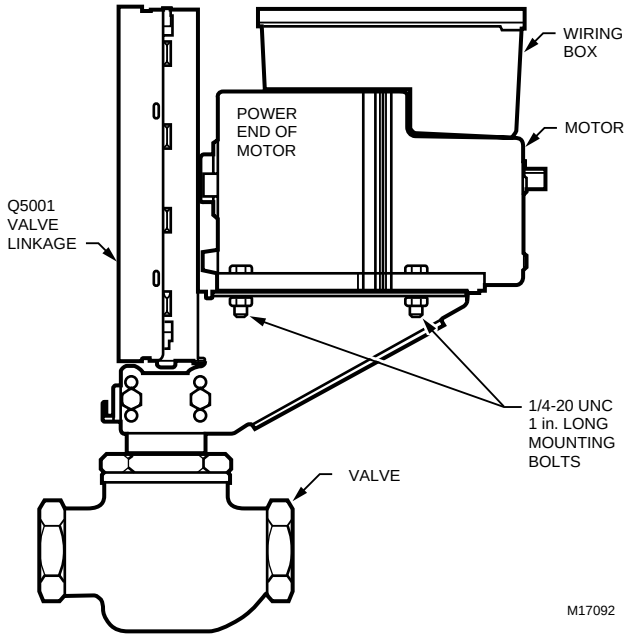


Fig. 4. Mounting the motor on a Q5001 Valve Linkage.

Wiring

⚠ CAUTION

Electrical Shock or Equipment Damage Hazard.
Can shock individuals or short equipment circuitry.
Disconnect all power supplies before installation. Motors with auxiliary switches can have more than one disconnect.

IMPORTANT

All wiring must agree with applicable codes, ordinances and regulations.

1. Ensure that the voltage and frequency stamped on the motor correspond with the power supply characteristics.
2. When connecting several motors in parallel, ensure that the power supply VA rating is large enough to provide power to all motors used without overloading.
3. Fig. 5 shows that motor terminals are quick-connects located on top of the printed circuit board.
4. To access the wiring compartment:
   a. Remove the four screws from the junction box top.
   b. Lift off the cover.
5. Fig. 6 shows the internal wiring schematic.
6. Refer to Fig. 7 and 8 for typical wiring.

Wire the motor as follows:

1. Remove the wiring box cover by removing the four screws holding the cover to the motor.
2. Wire motor to system using quick-connect terminals in wiring box.
3. Replace wiring box cover.

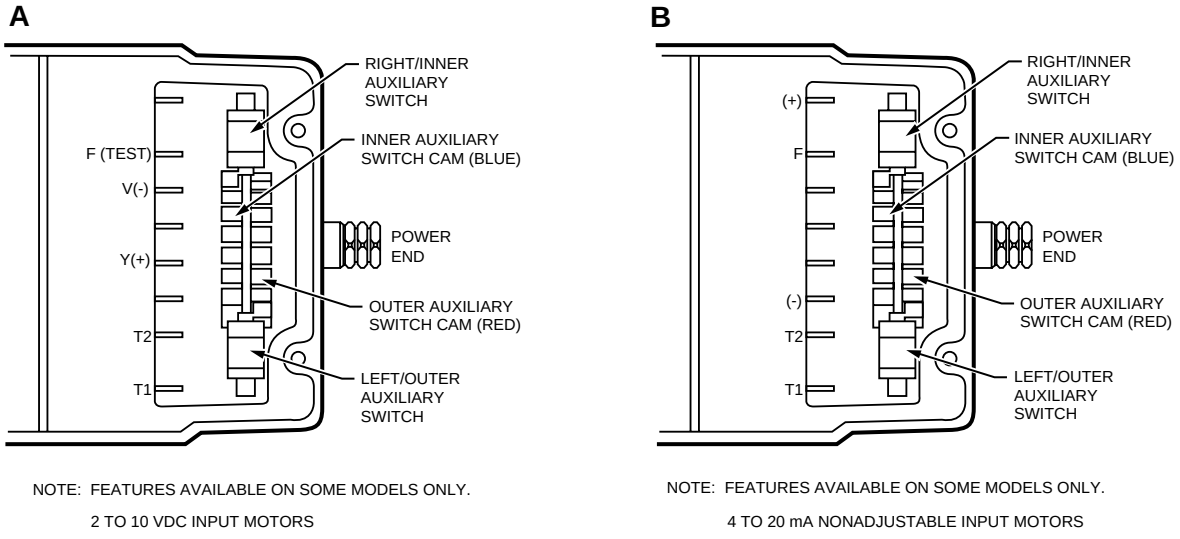
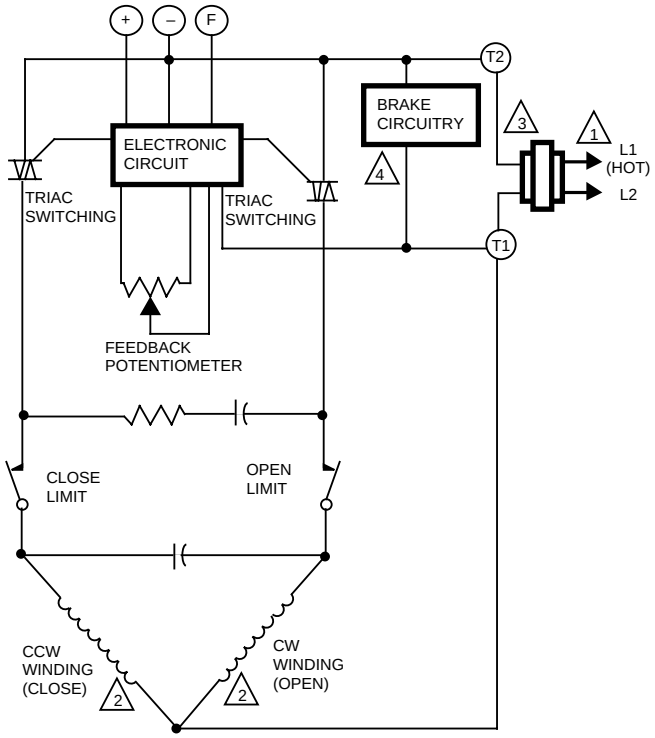


Fig. 5. Terminals and adjustments.



1 POWER SUPPLY. PROVIDE DISCONNECT MEANS AND OVERLOAD PROTECTION AS REQUIRED.

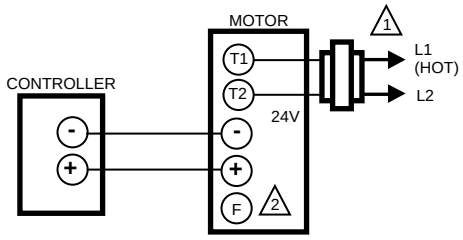
2 DIRECTION OF MOTOR TRAVEL AS VIEWED FROM POWER END.

3 INTERNALLY MOUNTED TRANSFORMER. DO NOT CONNECT POWER SUPPLY TO T1 AND T2.

4 BRAKE CIRCUITRY ONLY ON SPRING RETURN MODELS.

M5511

Fig. 6. Series 72 motor internal wiring schematic.

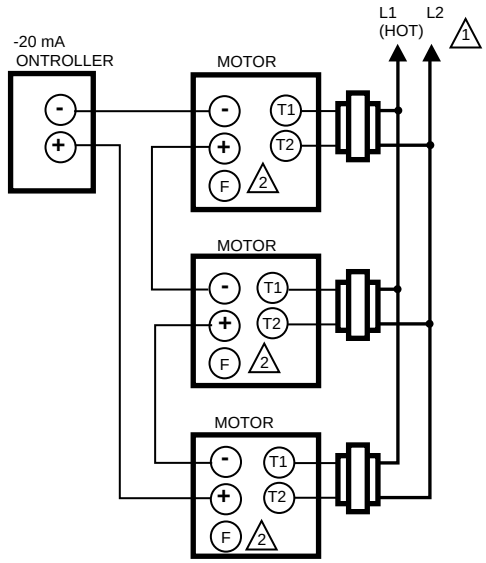


1 POWER SUPPLY. PROVIDE DISCONNECT MEANS AND OVERLOAD PROTECTION AS REQURED.

2 CONNECTING F TO – WILL DRIVE MOTOR TO FULLY OPEN.

M5778

Fig. 7. Typical system wiring.



1 POWER SUPPLY. PROVIDE DISCONNECT MEANS AND OVERLOAD PROTECTION AS REQURED.

2 CONNECTING F TO – WILL DRIVE MOTOR TO FULLY OPEN.

M5774

Fig. 8. Driving up to six motors from one 4 to 20 mA controller.

SETTINGS AND ADJUSTMENTS

Zero and Span Adjustment for M7284Q and M7285Q Motors (Fig. 5.)

1. Adjust the start potentiometer fully clockwise (maximum zero) and the span potentiometer fully counterclockwise (minimum span).
2. Set the controller current to the value required to drive the motor to the closed position.
3. Turn the start potentiometer slowly counterclockwise until the motor begins to open. This is defined as the start or zero setting.
4. Set the controller current to the value required to drive the motor to the fully open position. The motor will open.
5. Turn the span potentiometer clockwise until the motor starts to close. The difference between the fully open span position current and the zero position current is defined as the operating span.
6. Recheck the start and readjust the span potentiometer P1 if necessary. Turn the start potentiometer clockwise to increase the zero position.
7. Recheck the span and readjust the span potentiometer if necessary. Turn it clockwise to increase the full span position.
8. For sequential operation, as shown in Fig. 9, repeat the above steps for each motor.

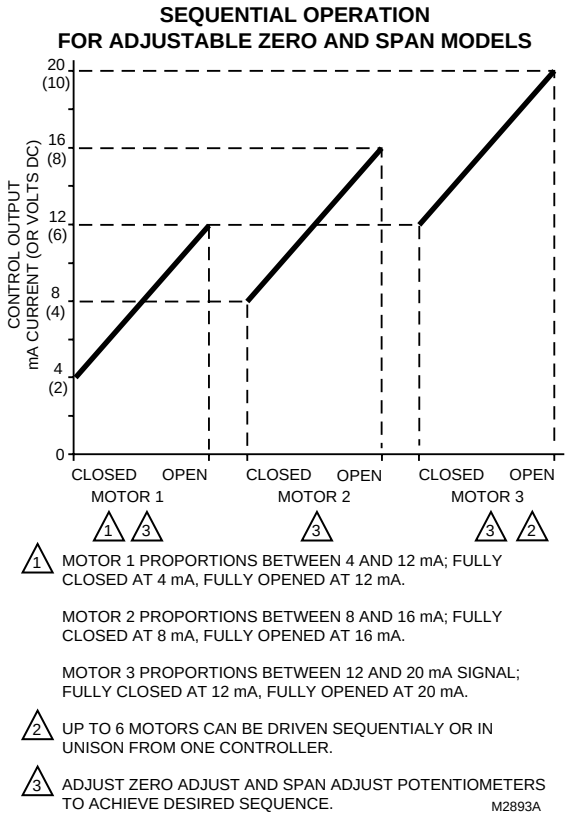


Fig. 9. Sequential operation of motors.

Auxiliary Switches

CAUTION

Electrical Shock or Equipment Damage Hazard.
Can shock individuals or short equipment circuitry.
Disconnect all power supplies before installation. Motors with auxiliary switches can have more than one disconnect.

CAUTION

Equipment Damage Hazard.
Can damage the motor beyond repair.
Never turn the motor shaft by hand or with a wrench. Forcibly turning the motor shaft damages the gear train and stroke limit contacts.

Adjustable cams actuate the auxiliary switches. These cams can be set to actuate the switches at any angle within the motor stroke. Select switch differential of 1° or 10°.

Motors with factory added auxiliary switches are shipped in the closed position (fully counterclockwise, as viewed from the motor power end) with auxiliary cams set to actuate switches 30° from the closed position and to provide 1° degree differential. With the motor in the closed (fully counterclockwise) position, the auxiliary switch breaks contacts R-B. See Fig. 10 for auxiliary switch wiring.

TRADELINE Motors are shipped with auxiliary switch cams that permit acceptance of 220736A,B Internal Auxiliary Switch Kits. Refer to form 63-2228 for 220736A,B Installation Instructions.

Auxiliary Switch Adjustment

IMPORTANT

When adjusting the auxiliary switch cams use the following procedure:

1.Insert 1/8 in. screwdriver blade into a slot on cam and move the screwdriver top as far as possible in the required direction. See Fig. 10.

2.Repeat step 1 in successive cam slots until the cam is in the required position.

Use the following procedure to obtain the desired auxiliary switch settings:

1. Remove the top cover from the motor to gain access to the motor terminals and auxiliary cams.
2. Disconnect the controller from the motor.
3. Connect a current source to the positive and negative terminals.
4. Drive the motor to the position where the auxiliary equipment is to be switched by increasing or decreasing the current.
5. For a switch differential of 1°, check continuity of auxiliary switch contacts R-B and rotate the cam as follows:
   a. If the contacts are open, rotate the cam clockwise until the R-B contacts close.
   b. If the contacts are closed, rotate the cam counterclockwise until the R-B contacts open.
6. For a switch differential of 10° rotate the cam approximately 180° so the slow-rise portion of the cam actuates the switch.
7. Check continuity of the auxiliary switch contacts R-B.
8. Rotate the cam as follows:
   a. If the contacts are open, rotate the cam counterclockwise until the R-B contacts close.
   b. If the contacts are closed, rotate the cam clockwise until the R-B contacts open.
   c. Make final adjustment in the proper direction to obtain contact make or break at the desired position.
9. Check for the proper differential and switching of the auxiliary equipment by driving the motor though the full stroke in both directions.
10. Disconnect power, remove current source, reconnect the controller, and replace the top cover on the motor.

NOTE: Changing the differential from 1° to 10° reverses the switching action. For example, with a 10° differential, switch contacts R-B make and R-W break on a counterclockwise (closed) rotation. With a 1° differential, switch contacts R-W make and R-B break on a counterclockwise (closed) rotation.

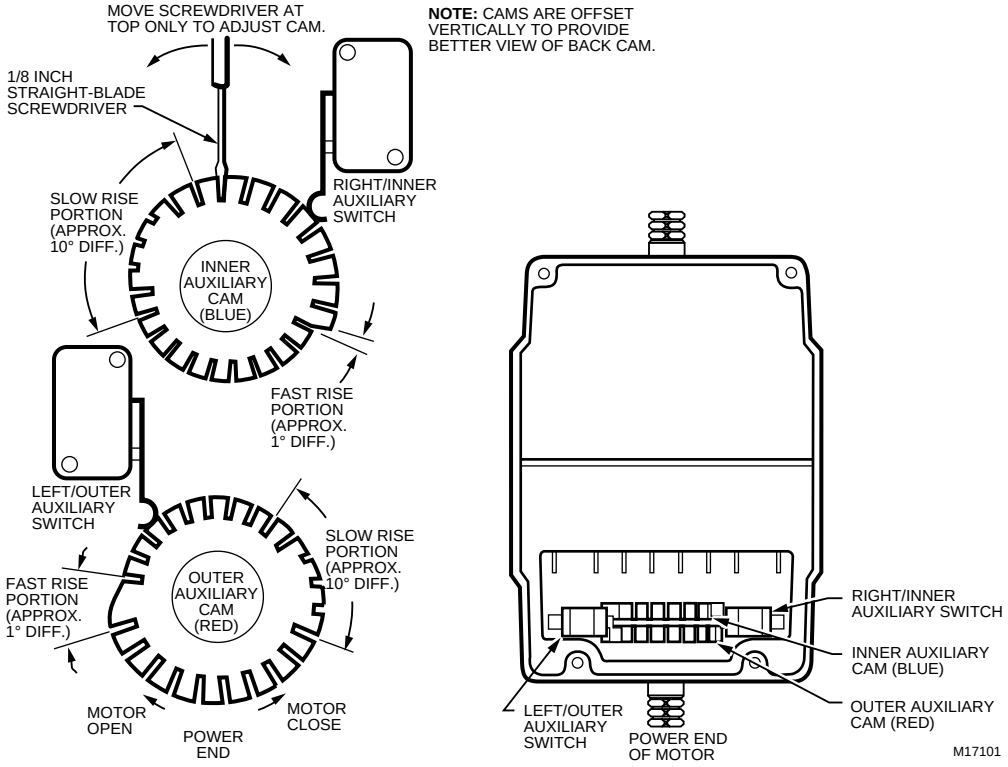

MOVE SCREWDRIVER AT TOP ONLY TO ADJUST CAM.
NOTE: CAMS ARE OFFSET VERTICALLY TO PROVIDE BETTER VIEW OF BACK CAM.
1/8 INCH STRAIGHT-BLADE SCREWDRIVER
RIGHT/INNER AUXILIARY SWITCH
SLOW RISE PORTION (APPROX. 10° DIFF.)
INNER AUXILIARY CAM (BLUE)
FAST RISE PORTION (APPROX. 1° DIFF.)
LEFT/OUTER AUXILIARY SWITCH
SLOW RISE PORTION (APPROX. 10° DIFF.)
FAST RISE PORTION (APPROX. 1° DIFF.)
OUTER AUXILIARY CAM (RED)
MOTOR OPEN
POWER END
MOTOR CLOSE
RIGHT/INNER AUXILIARY SWITCH
INNER AUXILIARY CAM (BLUE)
OUTER AUXILIARY CAM (RED)
LEFT/OUTER AUXILIARY SWITCH
POWER END OF MOTOR
M17101

Fig. 10. Auxiliary switch adjustment.

OPERATION AND CHECKOUT

Operation

The motor feedback potentiometer and control current input circuit form a bridge circuit. As long as the final control element remains at the position proportional to the input current from the controller, the circuit is balanced, and the motor does not run. When the value of the controlled medium changes, the current from the controller changes, and unbalance is amplified to energize the Triac switching to run the motor in the proper direction to correct the change in the temperature or the pressure. The motor turns the feedback potentiometer to rebalance the circuit and stop the motor.

Checkout

After installation and linkage adjustment, operate the motor through the controller. Make sure that:

- The motor properly operates the damper or valve.
- The motor responds properly as the input is varied.
- The auxiliary switch, if used, operates at the desired point of motor rotation.

Inspect the motor, linkage, and valve or damper to see that all mechanical connections are correct and secure.

In damper installations, the pushrod should not extend more than a few inches past the ball joints. Check to see that there is adequate clearance for the linkage to move through its stroke without binding or striking other objects.

See controller or system instructions for additional checkout procedures.

Motor Operation Checkout

Check motor operation as follows:

1. To close the motor, open terminals +, -, and F.
2. To open the motor, connect terminal F to the negative (-) motor terminal.

Honeywell

Home and Building Control
Honeywell
1985 Douglas Drive North
Golden Valley, MN 55422

Home and Building Control
Honeywell Limited-Honeywell Limitée
35 Dynamic Drive
Scarborough, Ontario
M1V 4Z9

Honeywell Asia Pacific Inc.
Room 3213-3225
Sun Hung Kai Centre
No. 30 Harbour Road
Wanchai
Hong Kong

Honeywell Europe S.A.
3 Avenue du Bourget
1140 Brussels
Belgium

Honeywell Latin American Region
480 Sawgrass Corporate Parkway
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VII

COMPONENT MANUALS GAS REGULATORS

Energy Metering

Regulator Installation and Maintenance Instructions

Model 121 Regulators

Introduction

The Model 121 Regulator represents a combination of capacity, performance and value...

Streamlined body passages provide large capacity. An external control line is required from lower case to control piping. The 121 has a fast speed of response, yet is stable in operation. Soft seats assure positive tight shutoff. Orifices are replaceable. Springs are color coded.

And it is also available as a zero governor or atmospheric regulator, a differential regulator, a relief valve or backpressure regulator, vacuum regulator or vacuum breaker.

Installation

1. Examine the regulator for shipping damage.
2. Check nameplate data. Be sure regulator conforms with what was ordered.
3. Inside of regulator and piping must be clean and free of dirt. Remove all dirt and debris before installing regulator. Failure to remove dirt/debris could result in regulator damage or trouble.
4. Remove all shipping screens and covers from the regulator. Do not let dirt get inside the regulator.
5. Install the regulator.
   Make sure the inlet and outlet are correctly connected. High pressure connects to the inlet. The flow arrow must point downstream.
6. Screwed connections must conform with good piping practice free of excess thread engagement per ANSI B2.1 Apply pipe joint compound to male threads only.
7. The Model 121 Regulator is usually right side-up as shown on the Typical Installation drawing (See Page 2). It may, however, be installed upside down. Although, when inverted it may be necessary to readjust the set-point.

   Caution: Do not install sideways. The diaphragm should be horizontal.
8. On indoor installations requiring venting outdoors, run the vent piping as short and direct as possible with minimum bends and elbows. Use the same size or larger pipe as the vent connections on the regulator. With natural gas, or any other hazardous gas, vent to a safe place outdoors in case gas should accidentally be discharged. Screen and protect the opening outdoors to guard against water, ice, dirt, debris or insects.
   Install the control line. Connect it into the outlet piping at least 5 pipe diameters downstream from the regulator.

   CAUTIONS:
   a. On backpressure regulators and relief valves the external control line connects into the **inlet** piping, 5 pipe diameters upstream from the regulator.
   b. Do not install any automatic shutoff device that closes completely between the regulator and the control line connection into the piping.

   To avoid excessive turbulence, the connection should be clean and smooth on the inside and be located in straight pipe clear of valves and fittings. Keep the inside of the control line clean and protect it from corrosion. Pitch it away from the regulator and avoid moisture pockets. It must be strong ($^1/_4$" for 121-8 and 121-12, $^1/_2$" for 121-16, or larger steel tubing or pipe is preferred). It must be well protected against breakage (remember...regulators open wide if the control line breaks).
9. Make sure the regulator is correctly connected and adequately supported and pipe joints are tight.

Start-Up

A. The inlet and outlet shutoff valves should both be closed. If a by-pass is used, the by-pass valve should also be closed.

B. Note the set-point (set-point is the outlet pressure the regulator is adjusted to deliver). Regulator is factory adjusted to the set-point specified on the order.

   CAUTION: This caution applies where the piping downstream of the outlet shutoff valve is pressured. That pressure must not exceed the regulator set-point by more than the pressure noted (see “Maximum Emergency Pressures”, Page 18).

C. Slowly and carefully open the **inlet** shutoff valve just enough to allow **inlet pressure** to build up slowly in the regulator until it is fully pressured.

   CAUTION: During start-up, a pressure gauge must be used on the regulator **outlet** pressure and carefully watched. While **inlet** pressure builds up, **outlet** pressure must not exceed set-point by more than 1 psi. If **outlet** pressure begins to exceed set-point by more than 1 psi, close the **inlet** shutoff valve. This indicates the regulator is not closing properly. Check and make necessary corrections before proceeding with start-up.
   If regulator **outlet** pressure exceeds set-point by more than the pressure noted, refer to “Maximum Emergency Pressures”, Page 18 for instructions.

D. Check installation for leaks.

E. Slowly open the outlet shutoff valve to allow a small flow (approximately 1000 SCFH). Make sure the flow of gas does not create a hazard.

   NOTE: If piping downstream of outlet shutoff valve is pressured, see “CAUTION” under B.

F. With gas flowing, check for correct inlet and outlet pressures. It may be necessary to further open the inlet shutoff valve to maintain full inlet pressure.

G. Make sure the regulator closes tight (tight lock-up). To do this, reduce flow to zero by slowly closing the outlet shutoff valve. Outlet pressure should not exceed set-point by more than 6" w.c.

H. Fully open inlet and outlet shutoff valves. Do this slowly and carefully. Watch pressure gauges.

I. Complete start-up by making sure there are no leaks.

NOTE

- **Do not exceed the regulator’s pressure ratings. The regulator outlet has a lower pressure rating than the inlet. Do not expose the regulator outlet or control line to inlet pressure.**

  Regulator with external control may be used as an upstream monitor or upstream regulator in a monitor set. The control line must connect into the outlet piping downstream of the downstream regulator.
- **If the regulator is to be moved to another location, make sure its construction is compatible with the pressure and flow conditions.**

Temperature Limits

The Model 121 Regulator can be used for flowing temperatures from –20°F to 150°F.

Buried Service

The Model 121 Regulator is not recommended for buried service.

Set Point Adjustment

A. The 121 is factory adjusted as specified on the order. To change the set-point, readjust as follows:

1. Remove the top cap **1**.
2. Adjust set-point with adjustment button **3**, **3a** or **6**. Turn clockwise to increase and counterclockwise to decrease the outlet pressure.

NOTE: a. Only make this adjustment when gas is actually flowing through the regulator. The flow should be small (approximately 1000 SCFH). Do not adjust when the regulator is closed and there is no flow.

b. Do not increase the set-point beyond the upper limit of the outlet pressure range for the spring **9** (refer to spring tables, Page 3).

c. Always check the outlet pressure with a pressure gauge while adjusting the set-point.

3. When adjustment is complete, replace top cap **1**. Screw it securely into place. Leaving it off could cause unstable regulator operation.

CAUTION

It is the user's responsibility to assure that all regulator vents and/or vent lines exhaust to a non-hazardous location away from any potential sources of ignition. Where vent lines are used, it is the user's responsibility to assure that each regulator is individually vented and that common vent lines are not used.

To Change Spring

A. The outlet pressure ranges of spring **9** are given in the tables on Pages 3 and 4. To change the spring:

1. Remove top cap **1**.
2. Unscrew and remove adjustment button **3**, **3a** or **6** by turning counterclockwise, and remove spring **9**.
3. Insert new spring. Make sure it is positioned correctly at the bottom before replacing adjustment button **3**, **3a** or **6**.
4. Adjust for the desired outlet pressure per previous section "Set Point Adjustment".
5. When adjustment is complete, replace top cap **1**. Screw it securely into place. Leaving it off could result in unstable regulator operation.
6. New spring range should be marked on regulator. If old spring range appears on regulator, it should be removed.

CAUTION

The diaphragm case vent must be positioned to protect against flooding, drain water, ice formation, traffic, tampering, etc. The vent must be protected against nest building animals, bees, insects, etc. to minimize the chances for foreign material from collecting in the vent side of the regulator diaphragm.

Shutdown

A. To take the regulator out of service, close the **inlet** stop valve first. Close it carefully. Then close the **outlet** stop valve.

Before working on regulator, read the next section "General Servicing Instructions" and the applicable servicing instructions.

CAUTION

Turn gas on very slowly. If an outlet stop valve is used, it should be opened first. Do not overload diaphragm with a sudden surge of inlet pressure. Monitor the outlet pressure during start-up to prevent an outlet pressure overload.

General Servicing Instructions

A. Before any disassembly of the regulator make sure it is completely depressured. Pressure must be fully released from the inlet, the outlet and the control line connection. Failure to adequately depressure could result in serious personal injury.

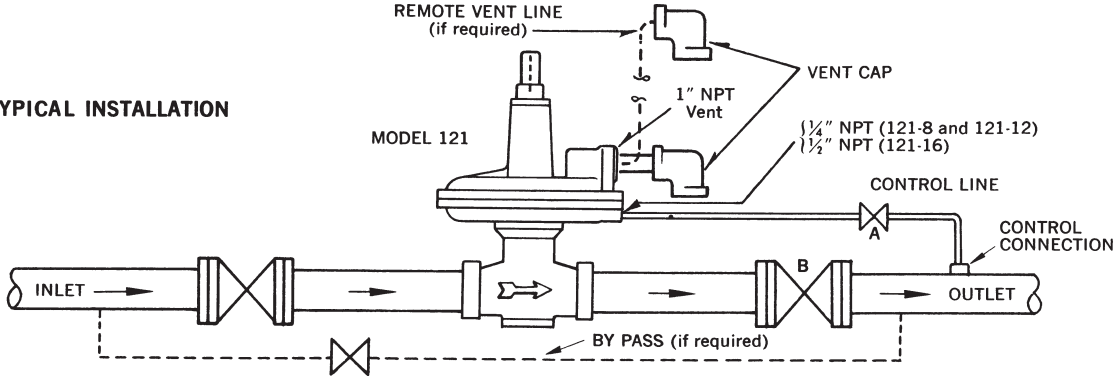
B. Carefully note the location and position of all disassembled parts to be certain reassembly is correct. Inspect each part carefully and replace any that are worn or damaged or otherwise unsatisfactory.

C. Upon completion of servicing, make certain that the regulator installation is entirely free of leaks.

CAUTION

Regulators are pressure control devices with numerous moving parts subject to wear that are dependent upon particular operating conditions. To assure continuous satisfactory operation, a periodic inspection schedule must be adhered to with the frequency of inspection determined by the severity of service and applicable laws and regulations.

TYPICAL INSTALLATION



Outlet Pressure Ranges and Springs

SIZE	OUTLET PRESSURE RANGE	SPRING COLOR	SPRING PART NUMBER	MAXIMUM INLET PRESSURE	NOMINAL DIAPHRAGM SIZE
3/4", 1" and 1 1/4"** Model 121-8	1 1/2" to 3 1/2" w.c.	Blue-Black Black-Red	143-82-021-01 (main spring) 121-10-021-50 (counterspring)	60 psi	8"
	1 1/2" to 12" w.c.	Green-Black Black-Red	143-82-021-02 (main spring) 121-10-021-50 (counterspring)		
	3 1/2" to 6 1/2" w.c. 5" to 8 1/2" w.c. 6" to 14" w.c. 12" to 28" w.c. 1 psi to 2 psi 2 psi to 4 1/4 psi	Red-Black Blue-Black Green-Black Green (2" O.D.) Orange (2" O.D.) Black	143-82-021-00 143-82-021-01 143-82-021-02 143-16-021-05 143-16-021-06 143-16-021-07		
3/4", 1" and 1 1/4"** Model 121-8HP	3 psi to 6 1/2 psi	Cadmium*	143-16-021-08	60 psi	8"
	6 psi to 10 psi	Cadmium* White	143-16-021-08 (outer) 143-16-021-13 (inner)		
1 1/2", 2" and 2 1/2" Model 121-12	1 1/2" to 3 1/2" w.c.	Red –	143-16-021-03 (main spring) 120-10-021-10 (counterspring)	60 psi	12"
	1 1/2" to 12" w.c.	Maroon –	121-42-021-00 (main spring) 120-10-021-10 (counterspring)		
	3 1/2" to 6 1/2" w.c. 5" to 8 1/2" w.c. 6" to 14" w.c. 12" to 28" w.c. 1 psi to 2 psi 1 1/2 psi to 3 psi	Red (2" O.D.) Blue (2" O.D.) Green (2" O.D.) Orange (2" O.D.) Black Cadmium	143-16-021-03 143-16-021-04 143-16-021-05 143-16-021-06 143-16-021-07 143-16-021-08		
1 1/2", 2" and 2 1/2" Model 121-8	1 psi to 2 psi 2 psi to 4 1/4 psi	Orange (2" O.D.) Black	143-16-021-06 143-16-021-07	60 psi	8"
1 1/2", 2" and 2 1/2" Model 121-8HP	3 psi to 6 1/2 psi	Cadmium*	143-16-021-08	60 psi	8"
	6 psi to 10 psi	Cadmium* White	143-16-021-08 (outer) 143-16-021-13 (inner)		
3" and 4" Model 121-16	3 1/2" to 6 1/2" w.c. 5" to 8 1/2" w.c. 6" to 14" w.c. 14" to 28" w.c. 1/2 psi to 1 1/4 psi	Red (3" O.D.) Blue (3" O.D.) Green (3" O.D.) Orange (3" O.D.) Yellow	121-62-021-50 121-62-021-51 121-62-021-52 121-62-021-53 121-62-021-56	40 and 15†	16"
3" and 4" Model 121-12	1 psi to 2 psi 1 1/2 psi to 3 psi	Black Cadmium	143-16-021-07 143-16-021-08	40 and 15†	12"

*Requires High Pressure Spring Adjustment. †3" 121 is 40 psi. and 4" 121 is 15 psi. **3/4" x 3/4" not available.

Atmospheric Regulator or Zero Governor

SIZE	OUTLET PRESSURE RANGE	SPRINGS
3/4", 1" and 1 1/4" 121-8	1 1/2" w.c. vacuum (–1 1/2" w.c.) to + 1 1/2" w.c.	Main Spring (Red-Black) ..... 143-82-021-00 Counterspring (Red-Black) 121-10-021-50
1 1/2", 2" and 2 1/2" 121-12	1" w.c. vacuum (–1" w.c.) to + 1 1/2" w.c.	Main Spring (Red-Black) ..... 143-82-021-00 Counterspring 120-10-021-10
3" and 4" 121-16	1 1/4" w.c. vacuum (–1 1/4" w.c.) to +1 1/4" w.c.	Main Spring only 121-62-021-54

Differential Regulator

SIZE	DIFFERENTIAL PRESSURE RANGE	SPRING COLOR	SPRING PART NUMBER	MAXIMUM BODY PRESSURE	MAXIMUM DIAPHRAGM PRESSURE DIFFERENTIAL	MAXIMUM DIAPHRAGM CASE PRESSURE
3/4", 1" and 1 1/4" 121-8**	3 1/2" to 6 1/2" w.c. 5" to 8 1/2" w.c. 6" to 14" w.c. 12" to 28" w.c. 1 psi to 2 psi	Red-Black Blue-Black Green-Black Green Orange (2" O.D.)	143-82-021-00 143-82-021-01 143-82-021-02 143-16-021-05 143-16-021-06	60 psi	2 psi	35 psi
1 1/2", 2" and 2 1/2" 121-12	3 1/2" to 6 1/2" w.c. 5" to 8 1/2" w.c. 6" to 14" w.c. 12" to 28" w.c. 1 psi to 2 psi	Red (2" O.D.) Blue (2" O.D.) Green (2" O.D.) Orange (2" O.D.) Black	143-16-021-03 143-16-021-04 143-16-021-05 143-16-021-06 143-16-021-07	60 psi	2 psi	20 psi
3" and 4" 121-16	3 1/2" to 6 1/2" w.c. 5" to 8 1/2" w.c. 6" to 14" w.c. 12" to 28" w.c.	Red (3" O.D.) Blue (3" O.D.) Green (3" O.D.) Orange (3" O.D.)	121-62-021-50 121-62-021-51 121-62-021-52 121-62-021-53	40 and 15*	1 psi	10 psi
3" and 4" 121-12	1 psi to 2 psi 1 1/2 psi to 3 psi	Black Cadmium	143-16-021-07 143-16-021-08	40 and 15*	2 psi	20 psi

*3" 121-16 is 40 psi. and 4" 121-16 is 15 psi. **3/4" x 3/4" not available.

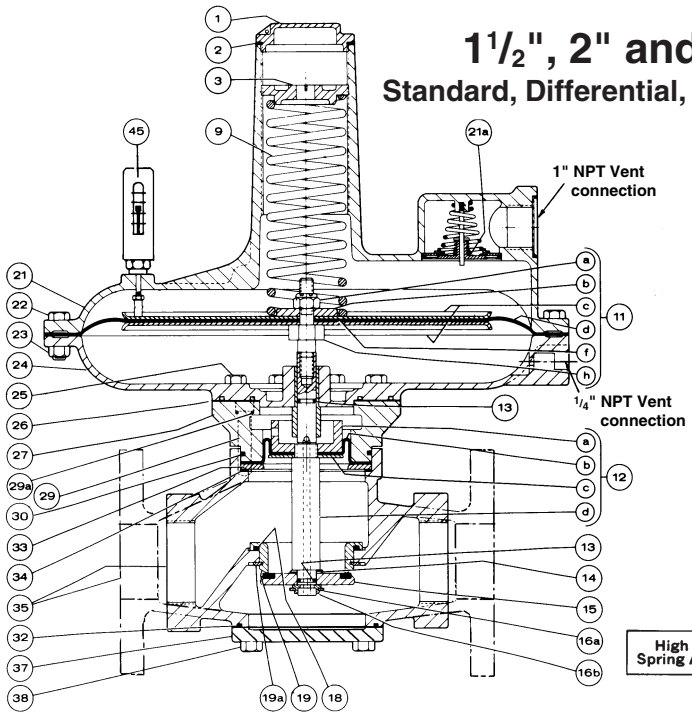
Back Pressure Regulator or Relief Valve

SIZE	RELIEF OR BACK PRESSURE RANGE	SPRING COLOR	PART NUMBER	MAX. DIAPHRAGM CASE PRESSURE
3/4" thru 2 1/2" 121-8**	3" to 5 1/2" w.c. 5" to 7 1/2" w.c. 6" to 13" w.c. 10" to 15" w.c. 12" to 25" w.c. 18" w.c. to 2 psi 1 psi to 4 psi	Red-Black Blue-Black Green-Black Blue (2" O.D.) Green (2" O.D.) Orange (2" O.D.) Black	143-82-021-00 143-82-021-01 143-82-021-02 143-16-021-04 143-16-021-05 143-16-021-06 143-16-021-07	10 psi
3/4" thru 2 1/2" 121-8**	3 psi to 6 psi 6 psi to 10 psi	Cadmium* [Cadmium (outer)*] White (inner)	143-16-021-08 143-16-021-08 143-16-021-13	20 psi
1 1/2", 2" and 2 1/2" 121-12	3" to 5 1/2" w.c. 5" to 7" w.c. 6" to 12" w.c. 12" to 25" w.c.	Red (2" O.D.) Blue (2" O.D.) Green (2" O.D.) Orange (2" O.D.)	143-16-021-03 143-16-021-04 143-16-021-05 143-16-021-06	10 psi
1 1/2" thru 4" 121-12	20" w.c. to 1 3/4 psi 1 1/2" to 2 3/4 psi	Black Cadmium	143-16-021-07 143-16-021-08	
3" and 4" 121-16	3" to 4 1/2" w.c. 3" to 6" w.c. 5" to 11" w.c. 10" to 24" w.c. 14" w.c. to 1 1/4 psi	Red (3" O.D.) Blue (3" O.D.) Green (3" O.D.) Orange (3" O.D.) Yellow	121-62-021-50 121-62-021-51 121-62-021-52 121-62-021-53 121-62-021-56	5 psi

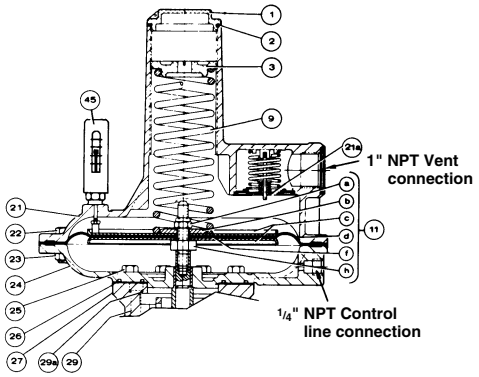
*Require High Pressure Spring Adjustment (121-8HP). ** 3/4" x 3/4" not available.

1½", 2" and 2½" Model 121

Standard, Differential, Atmospheric or Zero Governors

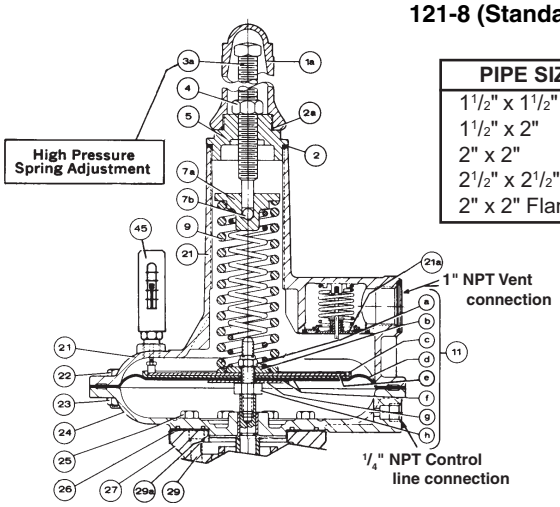


121-12 (Standard)



121-8 (Standard)

PIPE SIZES (inlet x outlet)	
1½" x 1½" 1½" x 2" 2" x 2" 2½" x 2½"	Screwed, NPT
2" x 2" Flanged ANSI 125 lb. FF	



121-8 HP (High Pressure)

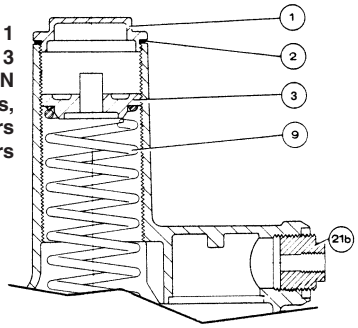
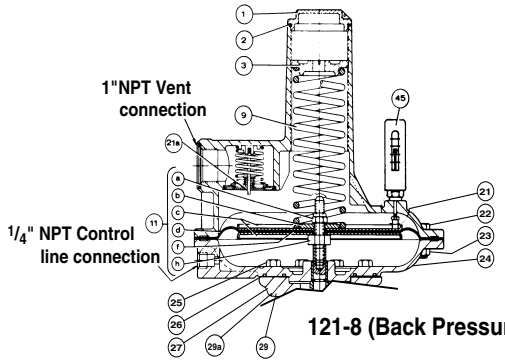


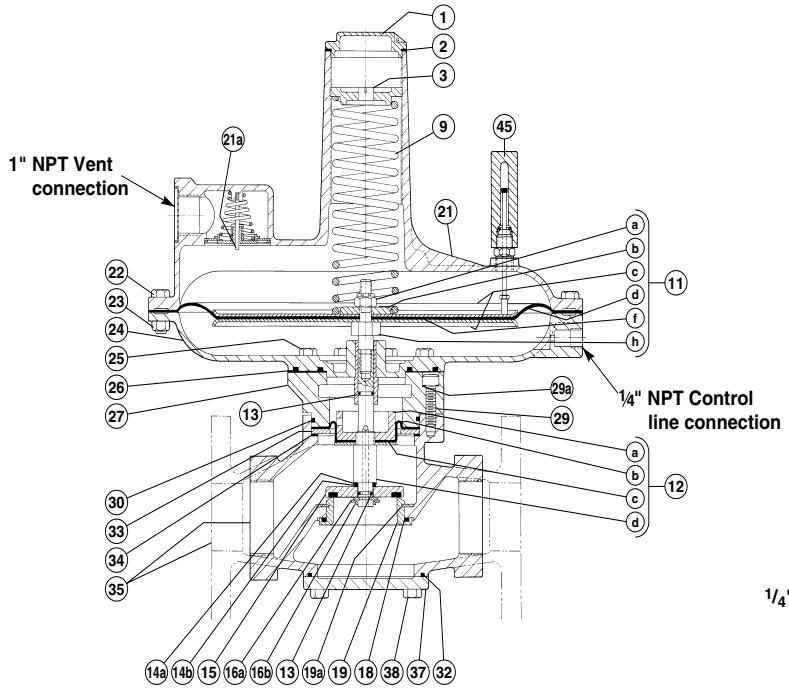
Fig. 1
ADJUSTMENT 3
and VENT CONNECTION
21b for Differential Regulators,
Atmospheric Regulators
and Zero Governors

1½", 2" and 2½" Model 121

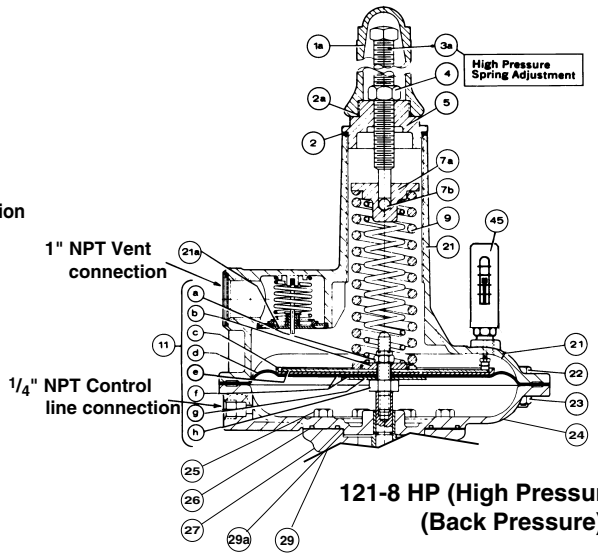
Back Pressure



121-8 (Back Pressure)



121-12 (Back Pressure)



121-8 HP (High Pressure)
(Back Pressure)

Condensed Parts List 1½", 2" and 2½"

ILL. NO.	DESCRIPTION	PART NUMBER
1	Seal Cap	143-16-005-00
1a	Seal Cap	121-10-005-52
2	Tetraseal (or O-Ring) 2¼" x 2⅜"	905241
2a	Tetraseal (or O-Ring) 1½" x 1⅝"	906534
3	Adjustment Spring Button	143-16-009-00
3a	Spring Adjusting Screw	906537
4	Hex Steel Nut	921005
5	Housing Cover	121-10-005-51
7a	Top Spring Button	121-10-009-51
7b	Thrust Bearing, stainless ball, ⅜" diameter	930510
9	Spring, see table "Spring Ranges"	
11	121-12 Diaphragm Assembly (3½" w.c. to 2 psi outlet pressure)	121-16-550-51
	11a Elastic Stop Nut 52-NTE-066	908561
	11b Bottom Spring Button	121-10-022-50
	11c Diaphragm Pan	121-16-017-50
	11d Molded Diaphragm, Buna-N	121-16-150-53
	11d Diaphragm, Viton	121-16-150-55
	11f Seal Washer	121-10-178-50
	11h Diaphragm Stud, stainless steel	121-16-058-52
11	121-8 Standard Diaphragm Assembly 1 psi to 4¼ psi outlet pressure)	121-10-551-52
	11a Elastic Stop Nut 29-NE-066	903955
	11b Bottom Spring Button	121-10-022-50
	11c Diaphragm Pan	121-10-017-50
	11d Diaphragm, Buna-N	121-10-150-50
	11d Diaphragm, Viton	121-10-150-52
	11f Seal Washer	121-10-178-50
	11h Diaphragm Stud, stainless steel	091-16-058-02
11	121-8 HP High Pressure Diaphragm Assembly (3 psi to 10 psi outlet pressure)	121-10-550-55
	11a Elastic Stop Nut 29-NE-066	903955
	11b Bottom Spring Button	121-10-022-53
	11c Diaphragm Pan	121-10-017-50
	11d Diaphragm, Buna-N	121-10-150-50
	11d Diaphragm, Viton	121-10-150-52
	11e Upper Plate	121-10-022-52
	11f Seal Washer	121-10-178-50
	11g Lower Plate	121-10-079-52
	11h Diaphragm Stud, stainless steel	091-16-058-02
12	121 Seal Diaphragm Assembly	121-16-564-51
	12a Piston	121-16-053-51
	12b Seal Diaphragm, Buna-N	121-16-364-50
	12b Seal Diaphragm, Viton	121-16-364-51
	12c Plate	121-16-010-53
	12d Stem, stainless steel	121-16-016-53

ILL. NO.	DESCRIPTION	PART NUMBER
13	O-Ring, Buna-N, ⅜" x ½"	934007
	O-Ring, Viton, ⅜" x ½"	902418
14	Wave Washer	905479
15	Molded Valve, Buna-N (45-50 Duro)	121-16-311-50
	Molded Valve, Viton-A (65-75 Duro)	121-16-311-51
16a	Retaining Ring	904447
	Pliers for retaining ring 16a, Truarc 0200	1190646
16b	Valve Holder, split (pair required), stainless steel	121-16-130-51
18	Tetraseal (or O-Ring) 2½" x 2¹¹/₁₆"	904207
19	Orifice, 2⁵/₃₂" dia., steel	121-16-023-51
	Orifice, 2⁵/₃₂" dia., stainless steel	121-16-023-52
19a	Retaining Ring, stainless	904657
	Pliers for retaining ring 19a, Truarc 0600	1190648
26	Gasket	121-16-063-51
29a	Copper Washer	121-16-178-51
30	O-Ring, 3⅛" x 3½"	934041
32	Tetraseal (or O-Ring) 3¼" x 3½"	904078
33	Seal Diaphragm Ring	121-16-008-50
34	Gasket	121-16-104-50
45	Travel Indicator	091-00-365-00
46	Repair Kits, consisting of Buna-N Main and Seal Diaphragms, Buna-N Molded Valve plus Wave Washer and Retaining Ring, Buna-N O-Rings, Tetraseals and Gaskets:	
	For 121-12	121-16-598-50
	For 121-8	121-86-598-50
	For 121-8 HP	121-86-598-51
	FOR BACK PRESSURE MODELS	
12	Item 12d above, Stem, Stainless Steel - substitute	
	Stem, Back Pressure	121-16-016-55
14	Item 14 above, Wave Washer - substitute	
	Poly-U Disk	121-16-102-52
	Retainer	121-16-103-50
46	Item 46 above, Repair Kits - substitute	
	For 121-12 Back Pressure	121-16-598-52
	For 121-8 Back Pressure	121-86-598-54
	For 121-8 HP Back Pressure	121-86-598-55
47	Add Item 47	
	Valve, Seal Diaphragm and Stem Assembly	121-16-511-51

Servicing – General Instructions

1. Make sure the regulator is entirely depressured before servicing.
2. Carefully note location and position of all disassembled parts to be certain reassembly is correct. Inspect each one carefully and replace those that are worn or damaged or otherwise unsatisfactory.
3. A moderate application of lubricant to O-ring **13** will help assure free stem movement and a tight seal. Similar application of lubricant to the other O-rings or Tetraseals will help assure their tightness.

   Do not use petroleum base lubricants.
4. Bolted connections should be tightened evenly and firmly.

   Carefully tighten diaphragms into place. Bolts must be tight enough to prevent leakage, but not so tight that the diaphragm material is crushed or damaged.
5. Upon completion of servicing, make certain that regulator installation is entirely free of leaks.

To Service Valve (15)

1. Remove bolts **38** and remove bottom cap **37** and Tetraseal **32**.
2. Remove retaining ring **16a**. Use Truarc 0200 pliers, Invensys Part No. 1190646.
3. Remove both halves of valve holder **16b**.
4. Remove valve **15** (wave washer **14** will probably also come off...do not lose it).

– To reassemble, replace parts in reverse sequence.

To Service Main Diaphragm (11d)

1. Remove top cap **1**, and release and remove adjustment **3**. On high pressure Model remove cap **1a**, release adjustment **3a**, and remove cover **5** and button **7a**. Mark or measure position of adjustment **3** or **3a**. Use this to return adjustment to this setting during reassembly.
2. Remove spring **9**.
3. Remove bolts **22** and upper case **21**.
4. Rotate diaphragm assembly **11** counterclockwise (this unscrews **11h** from **12d**) and remove.
5. To disassemble diaphragm assembly, remove nut **11a**. Carefully note location and position of all parts to be certain of correct reassembly. Abrasive side of emery cloth washers face against diaphragm.

– To reassemble, replace parts in reverse sequence.

Make the screwed connection between 11h and 12d loose by approximately 1/2 turn. To do this, carefully rotate diaphragm assembly **11** clockwise until this screwed connection bottoms (do not jam it together). Then, back-off diaphragm assembly **11** counterclockwise approximately 1/2 turn...this is very important...the **11h** to **12d** screwed connection must not be tight.

To Service Orifice (19)

1. Remove valve **15** per section “To Service Valve (**15**)”.
2. Remove main diaphragm assembly **11** per steps 1 through 4 “To Service Main Diaphragm (**11d**)”.
3. Remove seal diaphragm assembly **12** per steps 3 and 4 under “To Service Seal Diaphragm (**12b**)”.
4. Remove retaining ring **19a**. Use Truarc 0600 pliers, Invensys Part No. 1190648.
5. Remove orifice **19** through top opening.

– To reassemble, replace parts in reverse sequence.

(On reassembly, be sure that **19a** is fully seated in its groove. Also, beveled edge of **19a** faces downward toward bottom cap **37**.)

To Service Seal Diaphragm (12b)

1. Remove valve **15** per section “To Service Valve **(15)**”.
2. Remove main diaphragm assembly **11** per steps 1 through 4 “To Service Main Diaphragm (**11d**)”.
3. Remove bolts **25** and lower diaphragm case **24**.
4. Remove bolts **29** and centerpiece **27**, and then remove seal diaphragm assembly **12**.
5. To disassemble **12**, unscrew piston **12a** from stem **12d**. Use a spanner wrench in notch in skirt of piston (this can also be done by inserting a standard 7/32" Allen wrench in the notch).

– To reassemble, replace parts in reverse sequence.

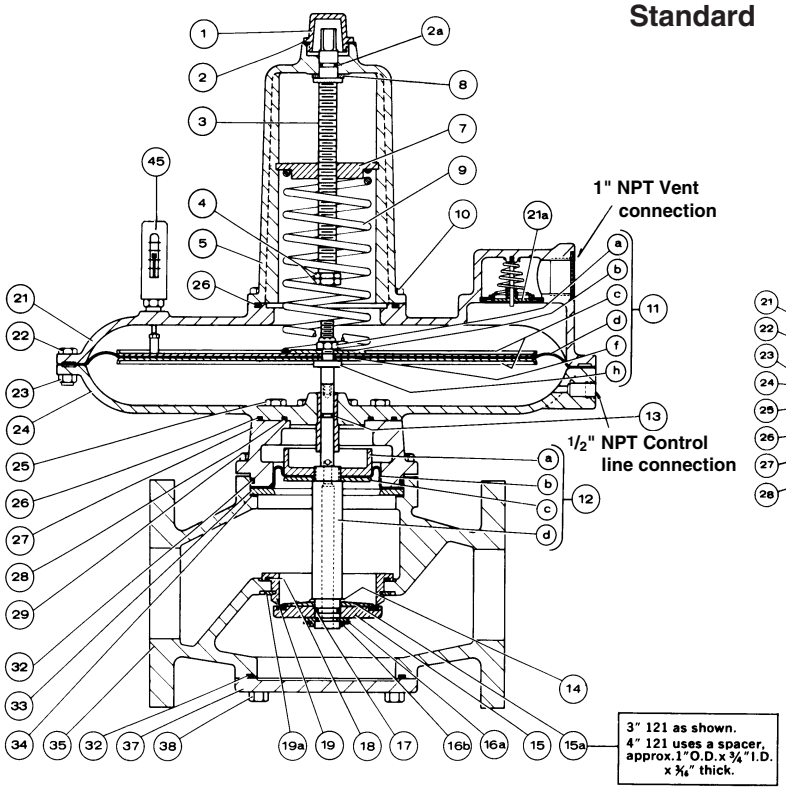
Make certain that fabric side of seal diaphragm **12b** faces upward and “rubber” side faces downward toward body.

Do not pinch loop in seal diaphragm **12b** between ring **33** and centerpiece **27**. Also, rounded edge of **33** faces upward toward seal diaphragm **12b**.

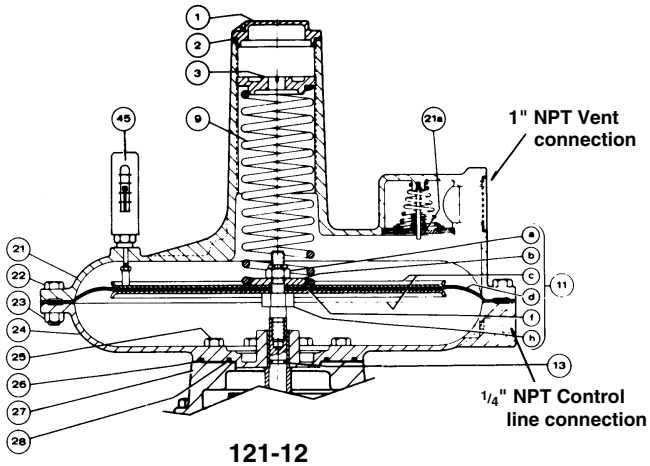
Periodic Inspection: Regulators are pressure control devices with numerous moving parts subject to wear that is dependent upon particular operation conditions. To assure continuous satisfactory operation, a periodic inspection schedule must be adhered to with the frequency of inspections, determined by the severity of service and applicable laws and regulations.

3" and 4" Model 121

Standard



121-16

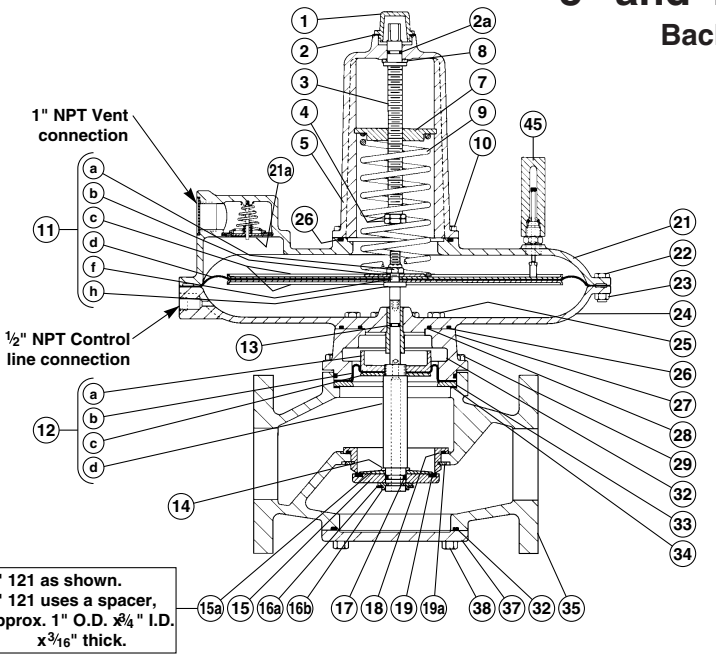


121-12

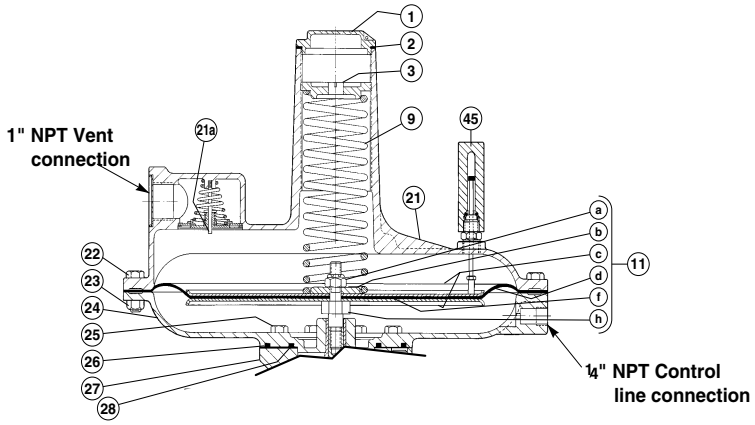
PIPE SIZES (inlet x outlet)	
3" x 3" 4" x 4"	Flanged ANSI 125 lb. FF

3" and 4" Model 121

Back Pressure



121-16



121-12 (Back Pressure)

Condensed Parts List 3" and 4"

	ILL. NO.	DESCRIPTION	PART NUMBER
3" and 4" Model 121	1	Seal Cap for 121-16	138-02-005-01
		Seal Cap for 121-12	143-16-005-00
	2	Seal Cap Gasket for 121-16	120-08-066-00
		Tetraseal for 121-12, $2^{1}/_{4}$", x $2^{3}/_{8}$"	905241
	3	Adjustment Spring Button for 121-12	143-16-009-00
	8	Thrust Washer	141-10-160-01
	9	Spring, see table "Spring Ranges"	
	11	121-16 Diaphragm Assembly	
		11a Elastic Stop Nut 52-NTE-066	908561
		11b Bottom Spring Button	121-62-022-50
		11c Diaphragm Pan	121-62-017-50
		11d Diaphragm, Buna-N	121-62-150-50
		11d Diaphragm, Viton	121-62-150-52
		11f Seal Washer	121-10-178-50
		11h Diaphragm Stud, stainless steel	121-16-058-52
	11	121-12 Diaphragm Assembly ($3^{1}/_{2}$" w.c. to 2 psi outlet pressure)	121-16-550-51
		11a Elastic Stop Nut 29-NE-066	903955
		11b Bottom Spring Button	121-10-022-50
		11c Diaphragm Pan	121-16-017-50
		11d Molded Diaphragm, Buna-N	121-16-150-53
		11d Diaphragm, Viton	121-16-150-55
		11f Seal Washer	121-10-178-50
		11h Diaphragm Stud, stainless steel	121-16-058-52
	13	O-Ring, Buna-N, $^{3}/_{8}$" x $^{1}/_{2}$"	934007
		O-Ring, Viton, $^{3}/_{8}$" x $^{1}/_{2}$"	902418
	14	Wave Washer	905481
	16a	Retaining Ring	904448
		Pliers for retaining ring 16a, Truarc 0400	1190647
	16b	Valve Holder, split (pair required), stainless steel	121-22-130-51
	17	O-Ring, Buna-N, $^{5}/_{8}$" x $^{3}/_{4}$"	902922
		O-Ring, Viton, $^{5}/_{8}$" x $^{3}/_{4}$"	902698
	26	Tetraseal (or O-Ring) $4^{3}/_{8}$" x $4^{5}/_{8}$"	904085
	28	Tetraseal (or O-Ring) $2^{3}/_{4}$" x 3"	904079
	46	Repair Kits, consisting of Buna-N Main and Seal Diaphragm, Buna-N Molded Valve plus Wave Washer and Retaining Ring, Buna-N O-Rings, Tetraseals and Gaskets:	
		For 3" 121-16	121-60-598-50
		3" 121-12	121-20-598-50
		4" 121-16	121-62-598-50
		4" 121-12	121-22-598-50
		FOR BACK PRESSURE MODELS	
	14	Item 14 above, Wave Washer - substitute	
		Poly-U Disk	121-22-102-52
		Retainer	121-22-103-50

	ILL. NO.	DESCRIPTION	PART NUMBER
3" Model 121 only	12	12a Piston	121-20-053-50
		12b Seal Diaphragm, Buna-N	121-20-364-50
		12b Seal Diaphragm, Viton	121-20-364-51
		12c Plate	121-20-010-50
		12d Stem, stainless steel	121-20-016-51
	15	Molded Valve, Buna-N (45-50 Duro)	121-20-311-50
		Molded Valve, Viton-A (65-75 Duro)	121-20-311-51
	15a	Valve Wing	121-20-018-50
		Valve Wing, stainless steel	121-20-018-51
	18	Tetraseal (or O-RIng) $3^{3}/_{4}$" x 4"	904200
	19	Orifice, $3^{1}/_{4}$" dia., steel	121-20-023-50
		Orifice, $3^{1}/_{4}$" dia., stainless steel	121-20-023-51
	19a	Retaining Ring, stainless	904658
		Pliers for retaining ring 19a, Truarc 0600	1190648
	32	Tetraseal (or O-Ring) 5" x $5^{1}/_{4}$"	934328
	33	Seal Diaphragm Ring	121-20-008-50
	34	Gasket	121-20-104-50
	45	Travel Indicator (specify scale 091-00-008-02)	091-00-365-00
		FOR BACK PRESSURE MODELS	
	12	Item 12d above, Stem - substitute	
	47	Stem, Back Pressure	121-20-016-53
		Add Item 47	
		Valve, Seal Diaphragm and Stem Assembly	121-20-511-50
4" Model 121 only	12	12a Piston	121-22-053-50
		12b Seal Diaphragm, Buna-N	121-22-364-50
		12b Seal Diaphragm, Viton	121-22-364-51
		12c Plate	121-22-010-50
		12d Stem, steel	121-22-016-50
		12d Stem, stainless steel	121-22-016-51
	15	Molded Valve, Buna-N (45-50 Duro)	121-22-311-50
		Molded Valve, Viton-A (65-75 Duro)	121-22-311-51
	15a	Valve Spacer	121-22-038-50
	18	Tetraseal (or O-Ring) $4^{3}/_{4}$" x 5"	950625
	19	Orifice, $4^{7}/_{32}$" dia., steel	121-22-023-50
	19a	Retaining Ring	904429
	20	Orifice, $4^{7}/_{32}$" dia., Stainless steel	121-22-023-52
	20a	Retaining Ring, stainless	121-22-130-52
		Pliers for retaining ring 19a, Truarc 0600	1190648
	32	O-Ring $6^{1}/_{4}$" x $6^{1}/_{2}$"	934337
	33	Seal Diaphragm Ring	121-22-008-50
	34	Gasket	121-22-104-50
	45	Travel Indicator (specify scale 091-00-008-02)	091-00-365-00
		FOR BACK PRESSURE MODELS	
	12	Item 12d above, Stem - substitute	
		Stem, Back Pressure	121-20-016-53
	47	Add Item 47	
		Valve, Seal Diaphragm and Stem Assembly	121-20-511-50

Servicing – General Instructions

Same general instructions as listed on Page 6.

To Service Valve (15)

1. Remove bolts **38** and remove bottom cap **37**.
2. Remove retaining ring **16a**. Use Truarc 0400 pliers, Invensys Part No. 1190647.
3. Remove both halves of valve holder **16b**.
4. Remove valve **15**, and wing **15a** or spacer (wave washer **14** will probably also come off...do not lose it).

– To reassemble, replace parts in reverse sequence.

To Service Main Diaphragm (11d)

1. Remove top cap **1**.
2. Release adjustment **3** (count the turns of adjustment **3** and use for returning the adjustment to this setting during reassembly).
3. Remove bolts **10** and housing **5** (3" and 4" 121-16 only).
4. Remove spring **9**.
5. Remove bolts **22** and upper case **21**.
6. Rotate diaphragm assembly **11** counterclockwise (this unscrews **11h** from **12d**) and remove.
7. To disassemble diaphragm assembly, remove nut **11a**. Carefully note location and position of all parts to be certain of correct reassembly. Abrasive side of emery cloth washers face against diaphragm.

– To reassemble, replace parts in reverse sequence.

Make the screwed connection between 11h and 12d loose by approximately 1/2 turn. To do this, carefully rotate diaphragm assembly **11** clockwise until this screwed connection bottoms (do not jam it together). Then, back-off diaphragm assembly **11** counterclockwise approximately 1/2 turn...this is very important...the **11h** to **12d** screwed connection must not be tight.

To Service Orifice (19)

1. Remove valve **15** per section “To Service Valve (**15**)”.
2. Remove seal diaphragm assembly **12** per step 2 under “To Service Seal Diaphragm (**12b**)”.
3. Remove retaining ring **19a**. Use Truarc 0600 pliers, Invensys Part No. 1190648.
4. Remove ring **33** and orifice **19** through top opening.

– To reassemble, replace parts in reverse sequence.

(On reassembly, be sure that **19a** is fully seated in its groove. Also, beveled edge of **19a** faces downward toward bottom cap **37**).

To Service Seal Diaphragm (12b)

1. Remove valve **15** per section “To Service Valve (**15**)”.
2. Remove bolts **29** and upper case assembly. Then remove seal diaphragm assembly **12**.
3. To disassemble **12**, unscrew piston **12a** from stem **12d**. Use a spanner wrench in notch in skirt of piston (this can also be done by inserting a standard 7/32" Allen wrench in the notch).

– To reassemble, replace parts in reverse sequence.

Make certain that fabric side of seal diaphragm **12b** faces upward and “rubber” side faces downward toward body.

Do not pinch loop in seal diaphragm **12b** between ring **33** and centerpiece **27**. Also, rounded edge of **33** faces upward toward seal diaphragm **12b**.

Make the screwed connection between 11h and 12d loose by approximately 1/2 turn. To do this, carefully rotate seal diaphragm assembly **12** clockwise until this screwed connection bottoms (do not jam it together). Then, back-off seal diaphragm assembly **12** counterclockwise approximately 1/2 turn...this is very important...the **11h** to **12d** screwed connection must not be tight.

Equimeter INCORPORATED

A BTR Metering Systems Company

General Safety Instructions for Gas Regulators

Keep this sheet for future reference.

AVOID OVERPRESSURIZATION

WARNING: Do not exceed the regulator's pressure ratings. Over-pressuring the regulator could damage it internally, cause leaks, or even result in personal injury by bursting a pressure containing part.

1. Refer to the appropriate REGULATOR INSTALLATION AND MAINTENANCE INSTRUCTIONS bulletin for pressure ratings. The regulator outlet has a lower pressure rating than the inlet. Do not expose the regulator outlet or control line to inlet pressure.

2. Regulators manufactured for use with a control line and having a diaphragm chamber sealed from the body outlet chamber may be used as the upstream regulator in a monitor set. The sealed body outlet chamber can be exposed to pressure higher than the normal outlet pressures. Do not use a regulator manufactured for internal control nor a regulator having a control line with an open throat as the upstream regulator in a monitor set. Doing so could result in a system failure where damage could occur along with personal injury.

3. Overpressure protection such as relief valves, automatic shutoff valves, monitors, etc., are recommended to protect both the inlet and outlet side of the regulator. If the inlet pressure is, or could be, greater than the emergency pressure rating for the regulator outlet or diaphragm chamber, install suitable over-pressure protection to prevent regulator damage and possible personal injury (see "Maximum Emergency Pressures" in the REGULATOR INSTALLATION AND MAINTENANCE INSTRUCTIONS bulletin). The use of an internal or external relief valve is recommended for installations subjected to no-flow for extended periods of time, such as pilotless ignition systems.

PRIOR TO INSTALLATION

1. Examine the regulator for shipping damage.

2. Check the name plate data. Make sure the regulator conforms with what was ordered.

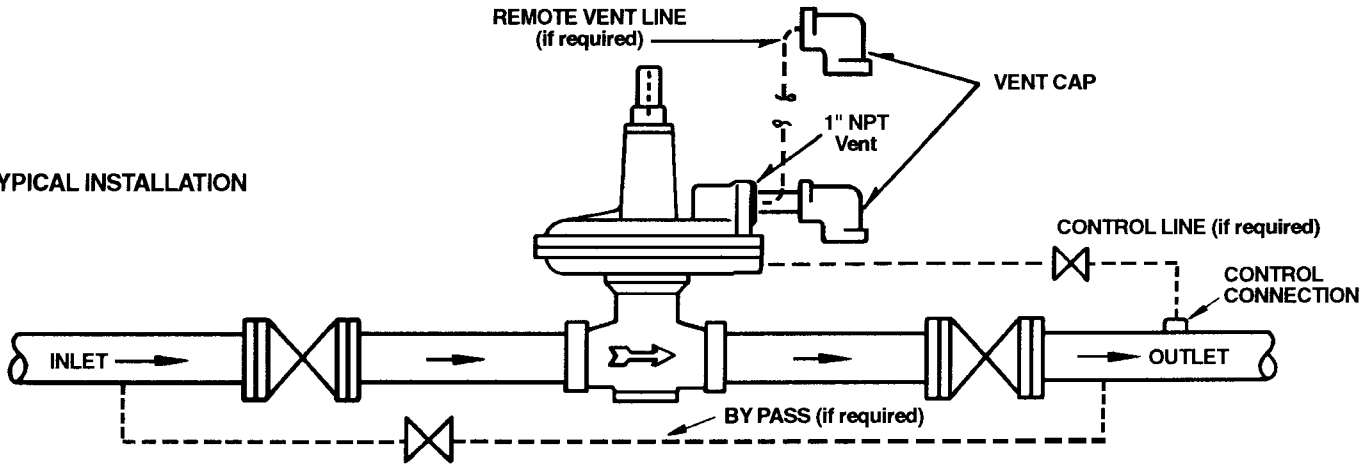
3. Provide suitable shut-off valves, conveniently located.

4. Protect the regulator from damage by vehicles or other outside sources.

5. The inside of the regulator and piping must be clean. Remove all dirt and debris before installing the regulator. Failure to do this could result in regulator damage and improper operation. Where there are dirt problems in the gas, it may be necessary to install a suitable filter or strainer upstream from the regulator.

6. Remove all shipping plugs and covers from the regulator before installing. Do not let dirt get inside.

TYPICAL INSTALLATION



INSTALLATION AND START-UP

1. Follow the appropriate REGULATOR INSTALLATION AND MAINTENANCE INSTRUCTIONS bulletin for the regulator when installing, operating, maintaining and servicing it. KEEP THE BULLETIN FOR FUTURE REFERENCE. If any of these instructions are not understood or there are any questions, phone your Equimeter sales representative.

2. Installation, operation, maintenance, and service must be done only by qualified persons.

3. Comply with all pertinent rules, regulations and codes (federal, state, local and insurance).

4. Make sure the inlet and outlet connections are correct. High pressure connects to the regulator inlet. The flow arrow on the body must point downstream.

5. Screwed connections must conform with good piping practice and be free of excess thread engagement (per ANSI B1.20.1). Apply pipe joint sealant to male threads only.

6. Tighten flanged joints evenly.

7. Before start-up, make sure the regulator is correctly connected, adequately supported and pipe joints are tight.

8. Check the regulator "set-point" and "lock-up" pressure. (Set-point is the outlet pressure the regulator is adjusted to deliver. Lock-up is the pressure where tight shutoff is achieved).

IMPORTANT: During start-up, a pressure gauge must be connected to the outlet piping between the regulator outlet and the downstream shutoff valve to closely monitor the outlet pressure. When checking the regulator for set-point and lock-up, provision must be made to PERMIT FREE FLOW of gas beyond the outlet valve.

The regulator set-point is factory adjusted as specified on the order. Set-point should be checked with small gas flow (10% of maximum regulator capacity or less). Open the valve downstream of the regulator before turning on gas. Slowly open the inlet valve while monitoring the outlet pressure gauge. Small flow should be set by adjusting the outlet valve.

WARNING: Always closely monitor the outlet pressure gauge during start-up while opening or closing valves and making adjustments. If the outlet pressure continues to increase above the specified lock-up pressure, open the downstream valve to discharge the excess pressure and close the inlet valve.

Only adjust set-point when gas is flowing through the regulator. DO NOT adjust if regulator is locked-up (tight shutoff).

IMPORTANT: Small flow during set-point adjustment is particularly important where set-point is in the top third of the spring range. Large flow could result in over-stressing the spring or loss of lock-up from the spring compressing solid. If the set-point adjustment must be made at large flow (60% to 100% of maximum regulator capacity) and set-point is in upper third of spring range, use the next higher range spring.

After set-point has been determined to be correct, check for lock-up by slowly closing the outlet valve. Again closely monitor the regulator outlet pressure gauge. Regulator must be fully capable of tight lock-up. If outlet pressure continues to rise above the lock-up pressure, open the downstream valve to discharge excess pressure and close the inlet shutoff valve. If the pressure goes above lock-up the regulator is not closing properly. Make the necessary corrections before resuming start-up.

9. Prompt attention is essential if there is regulator trouble, if gas leaks from the vent or elsewhere from the regulator, or if leaks develop in the piping. Failure to shut down the regulator may cause serious hazards.

10. The outlet of the vent piping must allow for the free and unobstructed passage of air and gas.

The diaphragm case vent must be positioned to protect against flooding, drain water, ice formation, traffic, tampering, etc. The vent must be protected against nest building animals, bees, insects, etc. to prevent vent blockage and minimize the chances for foreign material from collecting in the vent side of the regulator diaphragm.

It is the user's responsibility to assure that all regulator vents and/or vent lines exhaust to a non-hazardous location away from any potential sources of ignition. Where vent lines are used, it is the user's responsibility to assure that each regulator is individually vented and that common vent lines are not used.

MONITOR REGULATORS AND EXTERNAL CONTROL LINES

When bypassing a regulator with an external control line, the control line valve must be closed before the bypass valve is opened. Failure to do so could result in the diaphragm being exposed to the inlet pressure.

USE WITH OTHER GASES

1. Do not use Equimeter regulators on corrosive gases unless authorized by Equimeter for a specific corrosive condition.

2. Where the gas is propane or butane (LPG) and the regulator has an internal relief valve (IRV), special care is required with the regulator vent. Because propane and butane are heavier than air, they do not disperse readily in the atmosphere. Instead, they tend to collect in low places. Since large volumes can discharge from the regulator vent at times of emergency, care must be taken to pipe any such discharge to atmosphere at a safe place to prevent any gathering or migration of explosive mixtures in low areas.

GENERAL INSPECTION AND SERVICE INSTRUCTIONS

1. Inspect the regulator periodically to make sure it is in satisfactory working condition. Establish the frequency of inspection on the basis of severity of service and applicable laws and regulations. As a minimum recommendation, pressure regulating and limiting equipment should be inspected at intervals not exceeding 15 months, but at least once each calendar year.

2. If the regulator is to be moved to another location, make sure its construction is compatible with the new pressure and flow conditions.

WARNING: Before any disassembly of the regulator, make sure it is completely depressurized. Pressure must be fully released from the inlet, the outlet and any control line connections. Failure to adequately depressurize could result in serious injury.

3. Carefully note the location and position of all disassembled parts to be certain reassembly is correct. Inspect each part carefully and replace any that are worn, damaged or otherwise unsatisfactory.

4. Adjustment screw lubrication should be checked whenever the regulator is serviced. Make sure the threads are fully coated with lubricant. Where there is evidence of thread wear, such as loose fit or excessive sideplay, the worn parts must be replaced.

WARNING: Failure from worn threads can result in serious personal injury. Even at 10 psig outlet pressure, the force exerted on the adjustment screw by spring compression can be great. Therefore, adjustment screw lubrication and thread condition must be given careful attention.

5. Upon completion of servicing, make certain that the regulator installation is entirely free of leaks.

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VIII

COMPONENT MANUALS ASCO PILOT VALVE

Installation & Maintenance Instructions

2–WAY INTERNAL PILOT–OPERATED SOLENOID VALVES

NORMALLY CLOSED OPERATION – 3/8″, 1/2″, OR 3/4″ NPT

SERIES

8215

Form No.V5495R4

IMPORTANT: See separate solenoid installation and maintenance instructions for information on: Wiring, Solenoid Temperature, Causes of Improper Operation, Coil, or Solenoid Replacement.

DESCRIPTION

Series 8215 valves are 2–way normally closed internal pilot–operated solenoid valves. Valve bodies are made of rugged aluminum with trim and internal parts made of steel and stainless steel. Series 8215 valves may be provided with a general purpose, explosionproof, or watertight/explosionproof solenoid enclosure.

OPERATION

Normally Closed: Valve is closed when solenoid is de–energized; open when energized.

NOTE: No minimum operating pressure differential required.

INSTALLATION

CAUTION: Not all valves are approved for fuel gas service. Check nameplate for correct catalog number, pressure, voltage, frequency, and service. Never apply incompatible fluids or exceed pressure rating of the valve. Installation and valve maintenance to be performed by qualified personnel.

Future Service Considerations

Provision should be made for performing seat leakage, external leakage, and operational tests on the valve with a nonhazardous, noncombustible fluid after disassembly and reassembly.

Temperature Limitations

For maximum valve ambient and fluid temperatures, refer to chart below. Check catalog number prefix on nameplate to determine maximum temperatures.

Construction AC or DC	Coil Insulation Class	Catalog Number Prefix	Max. Ambient Temp °F	Max. Fluid Temp °F
AC	F	None	125	125
	H	H	140	140
DC 11.2 watts	F or H	None or HT	77	77
DC 11.6 watts	F or H	None or HB	104	104

Positioning

AC Construction: Valve is designed to perform properly when mounted in any position. However, for optimum life and performance, the solenoid should be mounted vertical and upright so as to reduce the possibility of foreign matter accumulating in the solenoid base sub–assembly area.

DC Construction: Valve must be mounted with solenoid vertical and upright.

Mounting

For mounting bracket (optional feature) dimensions, refer to Figure 1.

Piping

Connect piping to valve according to markings on valve body. Apply pipe compound sparingly to male pipe threads only. If applied to valve threads the compound may enter the valve and cause operational difficulty. Avoid pipe strain by properly supporting and aligning piping. When tightening the pipe, do not use valve or solenoid as a lever. Locate wrenches applied to valve body or piping as close as possible to connection point.

CAUTION: To avoid damage to the valve body, DO NOT OVERTIGHTEN PIPE CONNECTIONS. If Teflon* tape, paste, spray, or similar lubricant is used, use extra care when tightening due to reduced friction.

IMPORTANT: To protect the solenoid valve, install a strainer or filter, suitable for the service involved, in the inlet side as close to the valve as possible. Clean periodically depending on service conditions. See ASCO Series 8600, 8601, and 8602 for strainers.

MAINTENANCE

⚠ WARNING: To prevent the possibility of death, serious injury or property damage, turn off electrical power, depressurize valve, extinguish all open flames and avoid any type of sparking or ignition. Vent hazardous or combustible fluid to a safe area before servicing the valve.

NOTE: It is not necessary to remove the valve from the pipeline for repairs.

Service Notice

CAUTION: Series 8215C and 8215G valve parts are not interchangeable with Series 8215B valves. Series 8215B valves have a different valve body and a core/diaphragm sub–assembly with a diaphragm disc. Interchanging parts will cause valve malfunction. See Figure 1 for identification of parts.

Cleaning

All solenoid valves should be cleaned periodically. The time between cleanings will vary depending on the medium and service conditions. In general, if the voltage to the coil is correct, sluggish valve operation, excessive noise or leakage will indicate that cleaning is required. In the extreme case, faulty valve operation will occur and the valve may fail to open or close. Clean valve strainer or filter when cleaning the valve.

Preventive Maintenance

1. Keep the medium flowing through the valve as free from dirt and foreign material as possible.
2. While in service, the valve should be operated at least once a month to insure proper opening and closing.
3. Depending on the medium and service conditions, periodic inspection of internal valve parts for damage or excessive wear is recommended. Thoroughly clean all parts. If parts are worn or damaged, install a complete ASCO Rebuild Kit.

Causes of Improper Operation

1. **Incorrect Pressure:** Check valve pressure. Pressure to valve must be within range specified on nameplate.
2. **Excessive Leakage:** Disassemble valve and clean all parts. If parts are worn or damaged, install a complete ASCO Rebuild Kit.

Valve Disassembly

1. Remove solenoid, see separate instructions.
2. Unscrew solenoid base sub–assembly and body gasket.
3. Remove bonnet screws, valve bonnet, solenoid base gasket, core/diaphragm sub–assembly and body gasket.
4. All parts are now accessible to clean or replace. If parts are worn or damaged, install a complete ASCO Rebuild Kit.

Valve Reassembly

1. Lubricate solenoid base gasket and body gasket with DOW CORNING® 200 Fluid lubricant or an equivalent high–grade silicone fluid.
2. Install body gasket and core/diaphragm sub–assembly in valve body. Locate the bleed hole in the diaphragm assembly approximately 45° from valve *outlet.* The core/diaphragm sub–assembly is comprised of a rider ring, core spring, core guide, hanger spring, core assembly, and diaphragm assembly.

CAUTION: Do not distort hanger spring between core assembly and diaphragm assembly.

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3. Replace valve bonnet and bonnet screw on valve body. Hand thread screws a few turns into valve body, then torque bonnet screws in a crisscross manner to 70 ± 8 in−lbs [8,0 ± 0,9 Nm].
4. Install solenoid base gasket and solenoid base sub−assembly. Compress rider ring slightly to prevent damage when installing solenoid base sub−assembly. Torque solenoid base sub−assembly to 175 ± 25 in−lbs [19,8 ± 2,8 Nm].
5. Install solenoid, see separate instructions and make electrical hookup.

⚠ WARNING: To prevent the possibility of death, serious injury or property damage, check valve for proper operation before returning to service. Also perform internal seat and external leakage tests with a nonhazardous, noncombustible fluid.

6. Restore line pressure and electrical power supply to valve.
7. After maintenance is completed, operate the valve a few times to be sure of proper operation. A metallic "click" signifies the solenoid is operating.

ORDERING INFORMATION FOR ASCO REBUILD KITS

Parts marked with an asterisk(*) in the exploded view are supplied in Rebuild Kits.

• When Ordering Rebuild Kits for ASCO Valves, order the Rebuild Kit number stamped on the valve nameplate.+

+ If the number of the kit is not visible, order by indicating the number of kits required, and the Catalog Number and Serial Number of the valve(s) for which they are intended.

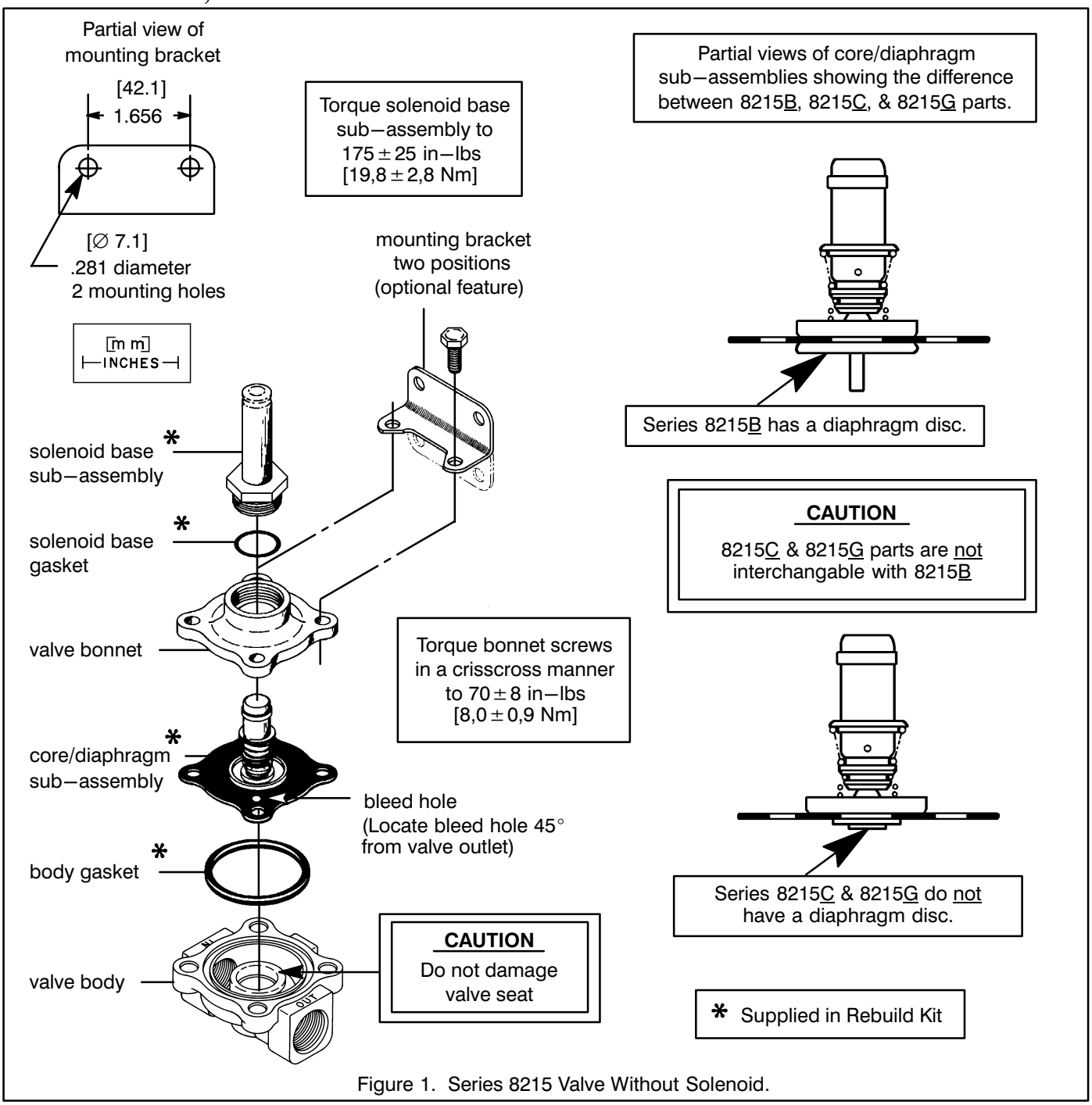
Partial view of mounting bracket
[42.1]
1.656
[∅ 7.1]
.281 diameter
2 mounting holes
[m m]
INCHES
Torque solenoid base sub−assembly to 175 ± 25 in−lbs [19,8 ± 2,8 Nm]
mounting bracket two positions (optional feature)
solenoid base sub−assembly *
solenoid base gasket *
valve bonnet
Torque bonnet screws in a crisscross manner to 70 ± 8 in−lbs [8,0 ± 0,9 Nm]
core/diaphragm sub−assembly *
bleed hole
(Locate bleed hole 45° from valve outlet)
body gasket *
valve body
CAUTION
Do not damage valve seat
Partial views of core/diaphragm sub−assemblies showing the difference between 8215B, 8215C, & 8215G parts.
Series 8215B has a diaphragm disc.
CAUTION
8215C & 8215G parts are not interchangable with 8215B
Series 8215C & 8215G do not have a diaphragm disc.
* Supplied in Rebuild Kit

Figure 1. Series 8215 Valve Without Solenoid.

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Installation & Maintenance Instructions

ASCO Red-Hat II®

OPEN–FRAME, GENERAL PURPOSE, WATERTIGHT/EXPLOSIONPROOF SOLENOIDS

SERIES
8003G
8202G
Form No.V6584R8

— SERVICE NOTICE —

ASCO® solenoid valves with design change letter "G" or "H" in the catalog number (ex. 8210G 1) have an epoxy encapsulated ASCO® Red Hat II® solenoid. This solenoid replaces some of the solenoids with metal enclosures and open–frame constructions. Follow these installation and maintenance instructions if your valve or operator uses this solenoid.

See separate instructions for basic valve.

DESCRIPTION

Catalog numbers 8003G and 8202G are epoxy encapsulated pull–type solenoids. The green solenoid with lead wires and 1/2″ conduit connection is designed to meet Enclosure Type 1–General Purpose, Type 2–Dripproof, Types 3 and 3S–Raintight, and Types 4 and 4X–Watertight. The black solenoid on catalog numbers prefixed "EF" or "EV" is designed to meet Enclosure Types 3 and 3S–Raintight, Types 4 and 4X–Watertight, Types 6 and 6P–Submersible, Type 7 (A, B, C & D) Explosionproof Class I, Division 1 Groups A, B, C, & D and Type 9 (E, F, & G)–Dust–Ignitionproof Class II, Division 1 Groups E, F & G. The Class II, Groups F & G Dust Locations designation is not applicable for solenoids or solenoid valves used for steam service or when a class "H" solenoid is used. See *Temperature Limitations* section for solenoid identification and nameplate/retainer for service. When installed just as a solenoid and not attached to an ASCO valve, the core has a 0.250–28 UNF–2B tapped hole, 0.38 or 0.63 minimum full thread.

NOTE: Catalog number prefix "EV" denotes stainless steel construction.

Catalog numbers 8202G1, 8202G3, 8202G5 and 8202G7 are epoxy encapsulated push–type, reverse–acting solenoids having the same enclosure types as previously stated for Catalog numbers 8003G1 and 8003G2.

Series 8003G and 8202G solenoids are available in:

- **Open–Frame Construction:** The green solenoid may be supplied with 1/4″ spade, screw or DIN terminals. (Refer to Figure 4)
- **Panel Mounted Construction:** These solenoids are specifically designed to be panel mounted by the customer through a panel having a .062 to .093 maximum wall thickness. Refer to Figure 1 and section on *Installation of Panel Mounted Solenoid.*

Optional Features For Type 1 – General Purpose Construction Only

- **Junction Box:** This junction box construction meets Enclosure Types 2,3,3S,4, and 4X. Only solenoids with 1/4″ spade or screw terminals may have a junction box. The junction box provides a 1/2″ conduit connection, grounding and spade or screw terminal connections within the junction box (See Figure 5).
- **DIN Plug Connector Kit No.K236034:** Use this kit only for solenoids with DIN terminals. The DIN plug connector kit provides a two pole with grounding contact DIN Type 43650 construction (See Figure 6).

OPERATION

Series 8003G – When the solenoid is energized, the core is drawn into the solenoid base sub–assembly. **IMPORTANT: When the solenoid is de–energized, the initial return force for the core, whether developed by spring, pressure, or weight, must exert a minimum force to overcome residual magnetism created by the solenoid. Minimum return force for AC construction is 11 ounces, and 5 ounces for DC construction.**

Series 8202G – When the solenoid is energized, the disc holder assembly seats against the orifice. When the solenoid is de–energized , the disc holder assembly returns. **IMPORTANT: Initial return force for the disc or disc holder assembly, whether developed by spring, pressure, or weight, must exert a minimum force to overcome residual magnetism created by the solenoid. Minimum return force is 1 pound, 5 ounces.**

INSTALLATION

Check nameplate for correct catalog number, service, and wattage. Check front of solenoid for voltage and frequency.

⚠ WARNING: Electrical hazard from the accessibility of live parts. To prevent the possibility of death, serious injury or property damage, install the open – frame solenoid in an enclosure.

FOR BLACK ENCLOSURE TYPES 7 AND 9 ONLY

⚠ CAUTION: To prevent fire or explosion, do not install solenoid and/or valve where ignition temperature of hazardous atmosphere is less than 165° C. On valves used for steam service or when a class "H" solenoid is used, do not install in hazardous atmosphere where ignition temperature is less than 180°C. See nameplate/retainer for service.

NOTE: These solenoids have an internal non–resetable thermal fuse to limit solenoid temperature in the event that extraordinary conditions occur which could cause excessive temperatures. These conditions include high input voltage, a jammed core, excessive ambient temperature or a shorted solenoid, etc. This unique feature is a standard feature only in solenoids with black explosionproof/dust–ignitionproof enclosures (Types 7 & 9).

⚠ CAUTION: To protect the solenoid valve or operator, install a strainer or filter, suitable for the service involved in the inlet side as close to the valve or operator as possible. Clean periodically depending on service conditions. See ASCO Series 8600, 8601, and 8602 for strainers.

Temperature Limitations

For maximum valve ambient temperatures, refer to chart. The temperature limitations listed, only indicate maximum application temperatures for field wiring rated at 90°C. Check catalog number prefix and watt rating on nameplate to determine maximum ambient temperature. See valve installation and maintenance instructions for maximum fluid temperature. NOTE: For steam service, refer to *Wiring* section, *Junction Box* for temperature rating of supply wires.

Temperature Limitations For Series 8003G or 8202G Solenoids for use on Valves Rated at 10.1, 11.6, 17.1, or 22.6 Watts

Watt Rating	Catalog Number Coil Prefix	Class of Insulation	Maximum † Ambient Temp.
10.1 & 17.1	None, FB, KF, KP SC, SD, SF, & SP,	F	125°F (51.7°C)
10.1 & 17.1	HB, HT, KB, KH, SS, ST, SU,	H	140°F (60°C)
11.6 & 22.6	None, FB,KF, KP, SC, SD, SF, & SP.	F	104°F (40°C)
11.6 & 22.6	HP, HT, KB, KH, SS, ST, SU, & SV	H	104°F (40°C)

† Minimum ambient temperature –40° F (–40° C).

Positioning

This solenoid is designed to perform properly when mounted in any position. However, for optimum life and performance, the solenoid should be mounted vertically and upright to reduce the possibility of foreign matter accumulating in the solenoid base sub–assembly area.

Wiring

Wiring must comply with local codes and the National Electrical Code. All solenoids supplied with lead wires are provided with a grounding wire which is green or green with yellow stripes and a 1/2″ conduit connection. To

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facilitate wiring, the solenoid may be rotated 360°. For the watertight and explosionproof solenoid, electrical fittings must be approved for use in the approved hazardous locations.

⚠ CAUTION: Cryogenic Applications — Solenoid lead wire insulation should not be subjected to cryogenic temperatures. Adequate lead wire protection and routing must be provided.

Additional Wiring Instructions For Optional Features:

- **Open−Frame solenoid with 1/4″ spade terminals.**

For solenoids supplied with screw terminal connections use #12−18 AWG stranded copper wire rated at 90°C or greater. Torque terminal block screws to 10 ± 2 in−lbs [1,0 ± 1,2 Nm]. A tapped hole is provided in the solenoid for grounding, use a #10−32 machine screw. Torque grounding screw to 15 − 20 in−lbs [1,7 − 2,3 Nm]. On solenoids with screw terminals, the socket head screw holding the terminal block to the solenoid is the grounding screw. Torque the screw to 15 − 20 in−lbs [1,7 − 2,3 Nm] with a 5/32″ hex key wrench.

- **Junction Box**

The junction box is used with spade or screw terminal solenoids only and is provided with a grounding screw and a 1/2″ conduit connection. Connect #12−18 AWG standard copper wire only to the screw terminals. Within the junction box use field wire that is rated 90°C or greater for connections. For steam service use 105°C rated wire up to 50 psi or use 125°C rated wire above 50 psi. After electrical hookup, replace cover gasket, cover, and screws. Tighten screws evenly in a crisscross manner.

- **DIN Plug Connector Kit No.K236034**

1. The open−frame solenoid is provided with DIN terminals to accommodate the plug connector kit.
2. Remove center screw from plug connector. Using a small screwdriver, pry terminal block from connector cover.
3. Use #12−18 AWG stranded copper wire rated at 90°C or greater for connections. Strip wire leads back approximately 1/4″ for installation in socket terminals. The use of wire−end sleeves is also recommended for these socket terminals. Maximum length of wire−end sleeves to be approximately 1/4″. Tinning of the ends of the lead wires is not recommended.
4. Thread wire through gland nut, gland gasket, washer and connector cover.

NOTE: Connector housing may be rotated in 90° increments from position shown for alternate positioning of cable entry.

5. Check DIN connector terminal block for electrical markings. Then make electrical hookup to terminal block according to markings on it. Snap terminal block into connector cover and install center screw.
6. Position connector gasket on solenoid and install plug connector. Torque center screw to 5 ± 1 in−lbs [0,6 ± 1,1 Nm].

NOTE: Alternating current (AC) and direct current (DC) solenoids are built differently. To convert from one to the other, it may be necessary to change the complete solenoid including the core and solenoid base sub−assembly, not just the solenoid. Consult ASCO.

Installation of Solenoid

Solenoids may be assembled as a complete unit. Tightening is accomplished by means of a hex flange at the base of the solenoid.

Installation of Panel Mounted Solenoid (See Figure 1)

1. Disassemble solenoid following instruction under *Solenoid Replacement* then proceed.
2. Install solenoid base sub−assembly through customer panel.
3. Position spring washer on opposite side of panel over solenoid base sub−assembly.
4. Replace solenoid, nameplate/retainer and red cap.
5. Make electrical hookup, see *Wiring* section.

Solenoid Temperature

Standard solenoids are designed for continuous duty service. When the solenoid is energized for a long period, the solenoid becomes hot and can be touched by hand only for an instant. This is a safe operating temperature.

MAINTENANCE

⚠ WARNING: To prevent the possibility of death, serious injury or property damage, turn off electrical power, depressurize solenoid operator and/or valve, and vent fluid to a safe area before servicing.

Cleaning

All solenoid operators and valves should be cleaned periodically. The time between cleaning will vary depending on medium and service conditions. In general, if the voltage to the solenoid is correct, sluggish valve operation, excessive noise or leakage will indicate that cleaning is required. Clean strainer or filter when cleaning the valve.

Preventive Maintenance

- Keep the medium flowing through the solenoid operator or valve as free from dirt and foreign material as possible.
- While in service, the solenoid operator or valve should be operated at least once a month to insure proper opening and closing.
- Depending on the medium and service conditions, periodic inspection of internal valve parts for damage or excessive wear is recommended. Thoroughly clean all parts. Replace any worn or damaged parts.

Causes of Improper Operation

- **Faulty Control Circuit:** Check the electrical system by energizing the solenoid. A metallic *click* signifies that the solenoid is operating. Absence of the *click* indicates loss of power supply. Check for loose or blown fuses, open−circuited or grounded solenoid, broken lead wires or splice connections.
- **Burned−Out Solenoid:** Check for open−circuited solenoid. Replace if necessary. Check supply voltage; it must be the same as specified on nameplate/retainer and marked on the solenoid. Check ambient temperature and check that the core is not jammed.
- **Low Voltage:** Check voltage across the solenoid leads. Voltage must be at least 85% of rated voltage.

Solenoid Replacement

1. Disconnect conduit, coil leads, and grounding wire.

NOTE: Any optional parts attached to the old solenoid must be reinstalled on the new solenoid. For 3−way construction, piping or tubing must be removed from pipe adapter.

2. Disassemble solenoids with optional features as follows:

- **Spade or Screw Terminals**

Remove terminal connections, grounding screw, grounding wire, and terminal block (screw terminal type only).

NOTE: For screw terminals, the socket head screw holding the terminal block serves as a grounding screw.

- **Junction Box**

Remove conduit and socket head screw (use 5/32″ hex key wrench) from center of junction box. Disconnect junction box from solenoid.

- **DIN Plug Connector**

Remove center screw from DIN plug connector. Disconnect DIN plug connector from adapter. Remove socket head screw (use 5/32″ hex key wrench), DIN terminal adapter, and gasket from solenoid.

3. Snap off red cap from top of solenoid base sub−assembly. For 3−way construction with pipe adapter (Figure 3), remove pipe adapter, nameplate and solenoid. Omit steps 4 and 5.
4. Push down on solenoid. Then using a suitable screwdriver, insert blade between solenoid and nameplate/retainer. Pry up slightly and push to remove.

NOTE: Series 8202G solenoids have a spacer between the nameplate/retainer and solenoid.

5. Remove solenoid from solenoid base sub−assembly.
6. Reassemble in reverse order of disassembly. Use exploded views for identification and placement of parts.
7. Torque pipe adapter to 90 inch−pounds maximum [10,2 Nm maximum]. Then make up piping or tubing to pipe adapter on solenoid.

Disassembly and Reassembly of Solenoids

1. Remove solenoid, see *Solenoid Replacement*.
2. Remove spring washer from solenoid base sub−assembly. For 3−way construction, remove plugnut gasket.
3. Unscrew solenoid base sub−assembly from valve body.
4. Remove internal solenoid parts for cleaning or replacement. Use exploded views for identification and placement of parts.
5. If the solenoid is part of a valve, refer to basic valve installation and maintenance instructions for further disassembly.
6. Torque solenoid base sub−assembly and adapter to 175±25 in−lbs [19,8±2,8 Nm].

ORDERING INFORMATION FOR ASCO SOLENOIDS

When Ordering Solenoids for ASCO Solenoid Operators or Valves, order the number stamped on the solenoid. Also specify voltage and frequency.

Torque Chart

Part Name	Torque Value Inch—Pounds	Torque Value Newton—Meters
solenoid base sub—assembly & adapter	175 ± 25	19,8 ± 2,8
pipe adapter	90 maximum	10,2 maximum

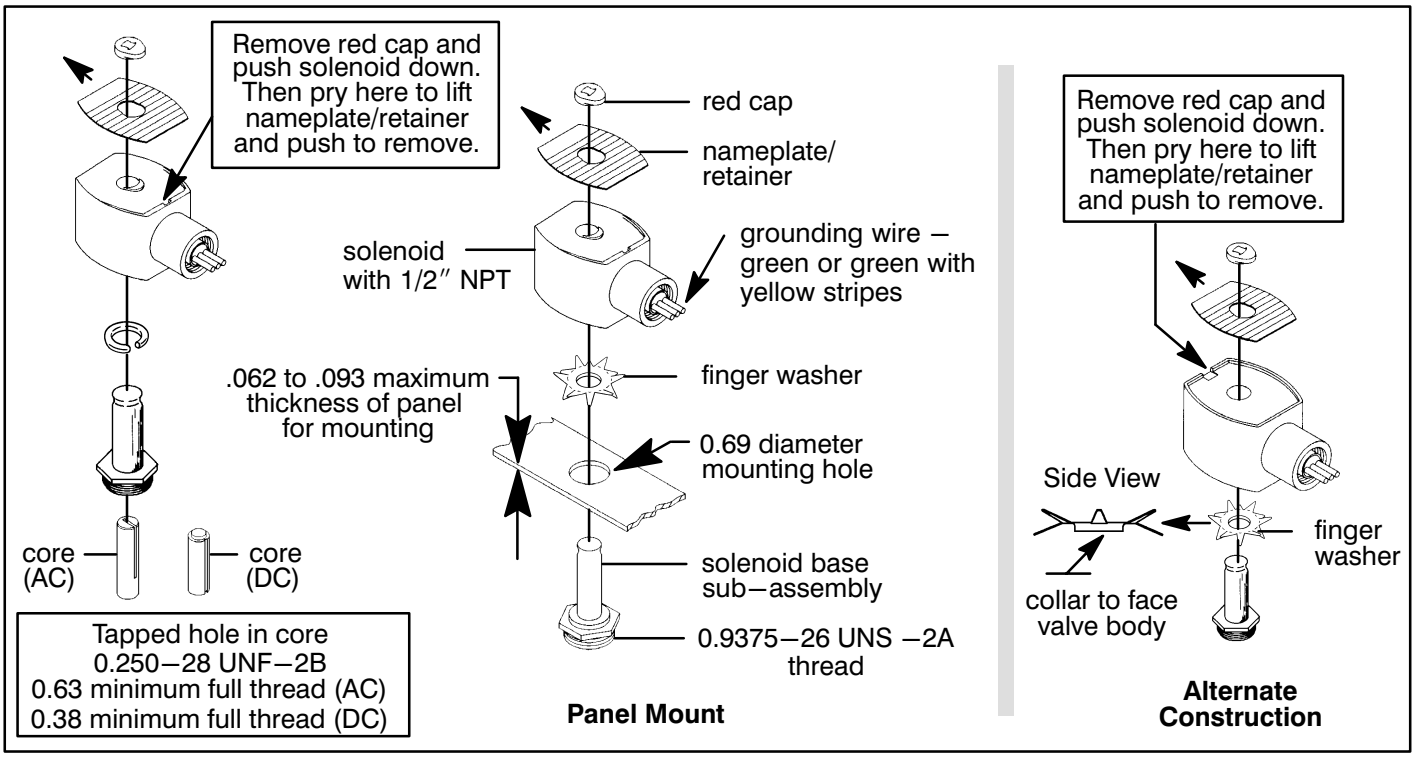

Remove red cap and push solenoid down. Then pry here to lift nameplate/retainer and push to remove.
red cap
nameplate/ retainer
solenoid with 1/2″ NPT
grounding wire — green or green with yellow stripes
.062 to .093 maximum thickness of panel for mounting
finger washer
0.69 diameter mounting hole
core (AC)
core (DC)
solenoid base sub—assembly
0.9375—26 UNS —2A thread
Tapped hole in core 0.250—28 UNF—2B 0.63 minimum full thread (AC) 0.38 minimum full thread (DC)
Panel Mount
Remove red cap and push solenoid down. Then pry here to lift nameplate/retainer and push to remove.
Side View
finger washer
collar to face valve body
Alternate Construction

Figure 1. Series 8003G solenoids

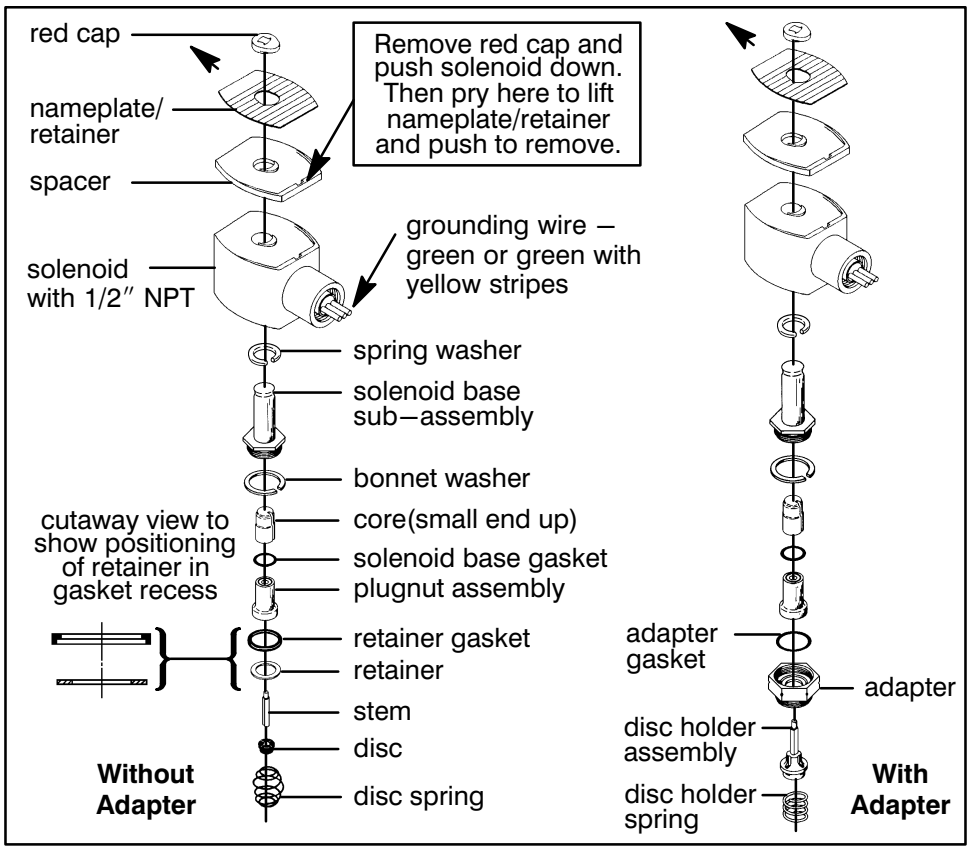


Figure 2. Series 8202G solenoids

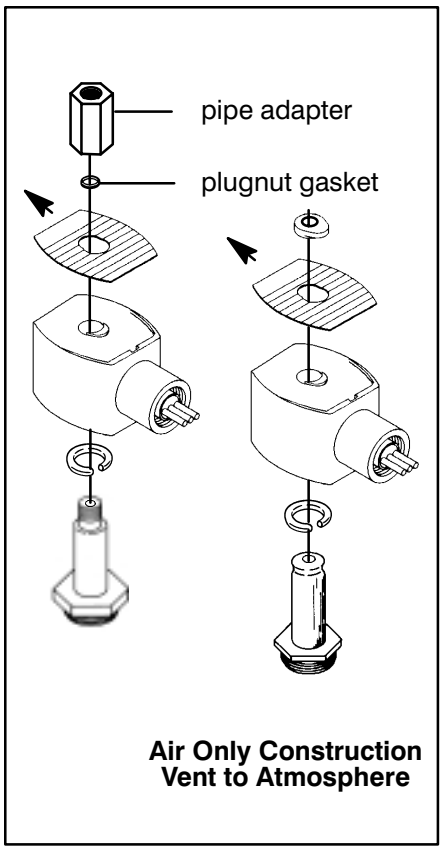


Figure 3. 3—Way Construction

ASCO® 50 Hanover Road, Florham Park, New Jersey 07932 www.ascovalve.com

Torque Chart

Part Name	Torque Value in Inch—Pounds	Torque Value in Newton—Meters
terminal block screws	10 ± 2	1,1 ± 0,2
socket head screw	15 — 20	1,7 — 2,3
center screw	5 ± 1	0,6 ± 0,1

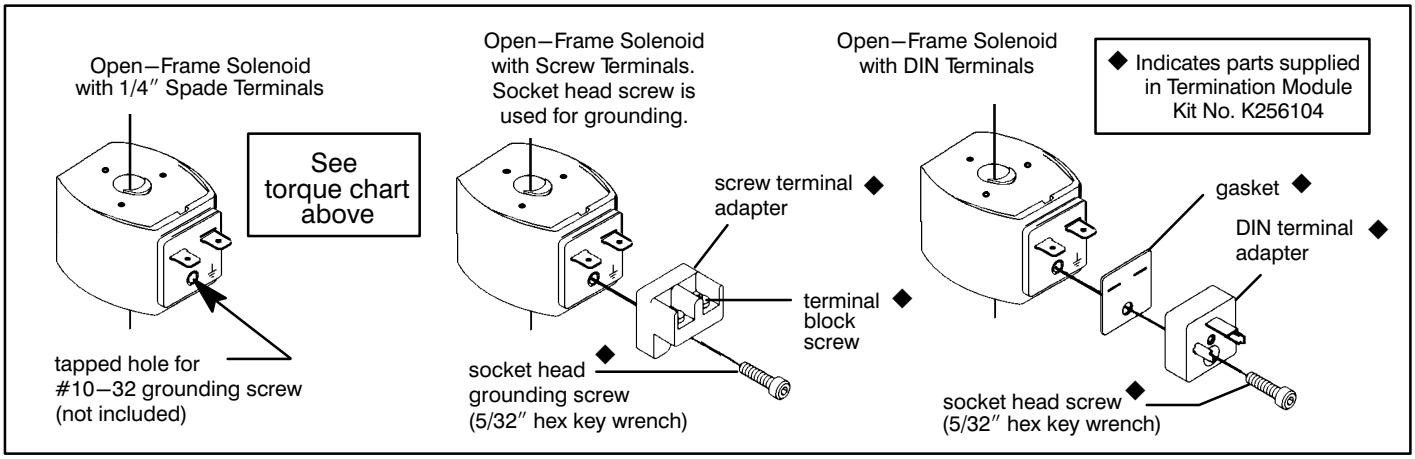

Open—Frame Solenoid with 1/4″ Spade Terminals
See torque chart above
tapped hole for #10—32 grounding screw (not included)
Open—Frame Solenoid with Screw Terminals. Socket head screw is used for grounding.
screw terminal adapter ◆
terminal block screw ◆
socket head grounding screw (5/32″ hex key wrench) ◆
Open—Frame Solenoid with DIN Terminals
◆ Indicates parts supplied in Termination Module Kit No. K256104
gasket ◆
DIN terminal adapter ◆
socket head screw (5/32″ hex key wrench) ◆

Figure 4. Open—frame solenoids

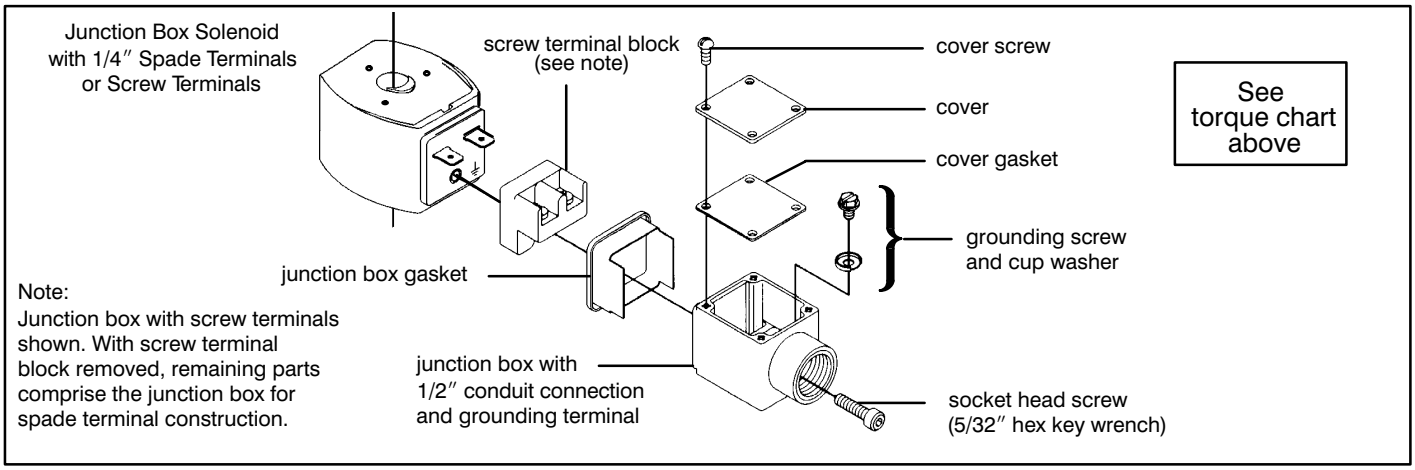

Junction Box Solenoid with 1/4″ Spade Terminals or Screw Terminals
screw terminal block (see note)
cover screw
cover
cover gasket
grounding screw and cup washer
junction box gasket
junction box with 1/2″ conduit connection and grounding terminal
socket head screw (5/32″ hex key wrench)
See torque chart above
Note:
Junction box with screw terminals shown. With screw terminal block removed, remaining parts comprise the junction box for spade terminal construction.

Figure 5. Junction box (optional feature)

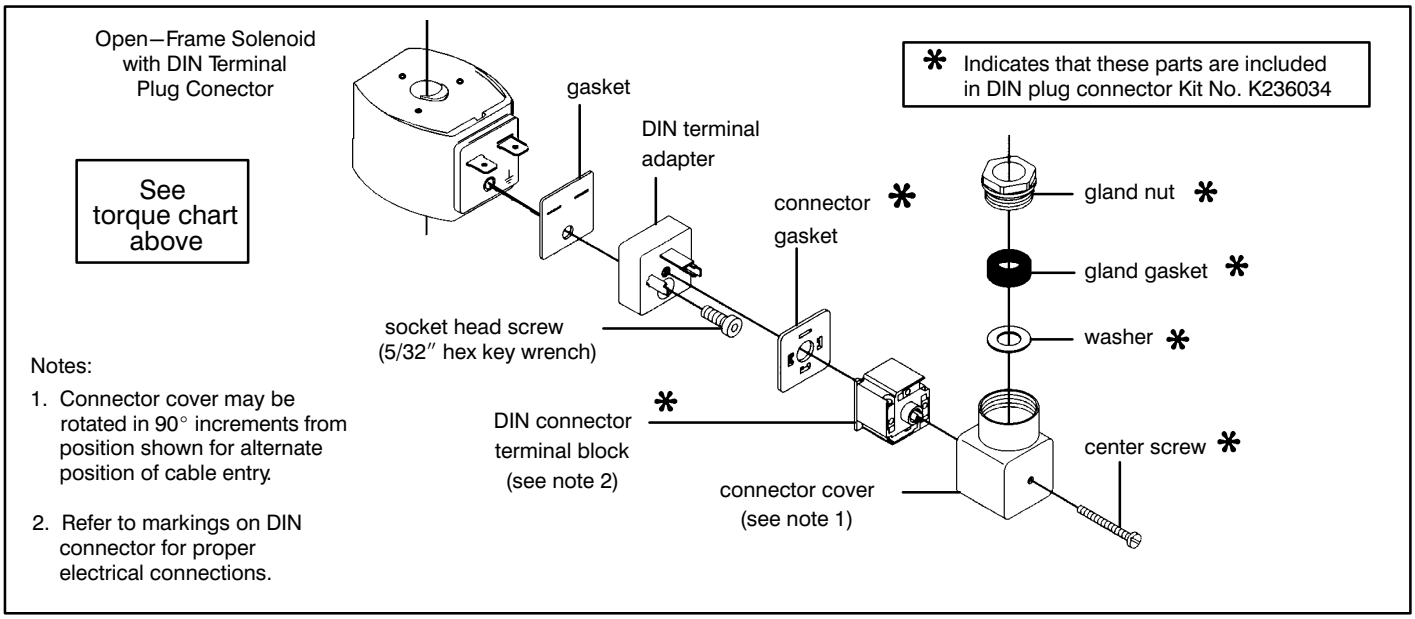

Open—Frame Solenoid with DIN Terminal Plug Conector
See torque chart above
* Indicates that these parts are included in DIN plug connector Kit No. K236034
gasket
DIN terminal adapter
connector gasket *
gland nut *
gland gasket *
washer *
socket head screw (5/32″ hex key wrench)
DIN connector terminal block (see note 2) *
center screw *
connector cover (see note 1)
Notes:
1. Connector cover may be rotated in 90° increments from position shown for alternate position of cable entry.
2. Refer to markings on DIN connector for proper electrical connections.

Figure 6. DIN plug connector kit No. K236034 (optional feature)

ASCO® 50 Hanover Road, Florham Park, New Jersey 07932 www.ascovalve.com

IX

COMPONENT MANUALS PROTECTOFIER

Protectofier

COMBUSTION SAFEGUARD

Form 6642 VA

Single Burner Supervision, Manual Pushbutton Ignition, Plug-in SS100A FLAME-PAK, Plug-in Control Relays

Power on PROTECTOFIER terminals L1 and L2 provides power to electronic network.

Terminal L1 must be powered before terminal 12.

Power on PROTECTOFIER terminal 12 (thru permissive safety limits circuit) permits manual pushbutton ignition.

1 Press and hold "START pilot pushbutton.

a. "ACF" CHECK relay "C" is energized thru N.C. contact of "ACF FLAME relay "F".

b. Ignition transformer is energized thru contact of "START" button (from PROTECTOFIER terminal 4) to provide spark ignition to the pilot.

c. Pilot solenoid valve is energized to open (from PROTECTOFIER terminal 4).

2. With pilot flame established "ACF" FLAME relay "F" is energized.

a. FLAME relay "F" contacts transfer.

1) N.C. "F" contact in safe-start checking circuit opens.

2) N.O. "F" contact between terminal 12 and terminal 13 closes providing holding circuit around "START" pilot push-button contact.

3) **N.O.** "F" contact in main valve circuit closes to energize main valve (thru N.O. CHECK relay "C" contact). Neon indicator light on PROTECTOFIER chassis will glow to indicate flame is established.

3. Release "START" button. Ignition transformer is de-energized.

Flame failure during operation de-energizes fuel valves

Power interruption to PROTECTOFIER terminal 12 de-energizes relays and fuel valves.

Failure of Check Relay "C" to prove safe-start check will prevent energizing fuel valves and ignition system.

PROTECTION CONTROLS, INC.

Power Equipment Company
Manufacturers Representative
2011 Williamsburg Rd. Richmond. VA 23231
(804)236-3800 Fax (804) 236-3882

INSTALLATION, OPERATION AND MAINTENANCE SHALL CONFORM WITH NATIONAL FIRE PROTECTION ASSOCIATION STANDARDS, NATIONAL AND LOCAL CODES, AND AUTHORITIES HAVING JURISDICTION. ANY MODIFICATION VOIDS APPROVALS.

PRINTED IN U S A '192

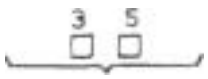
PROTECTOFIER

MANUAL OPERATION

S5100A FLAME PAK

ACF { C-CHECK RELAY
F-FLAME RELAY

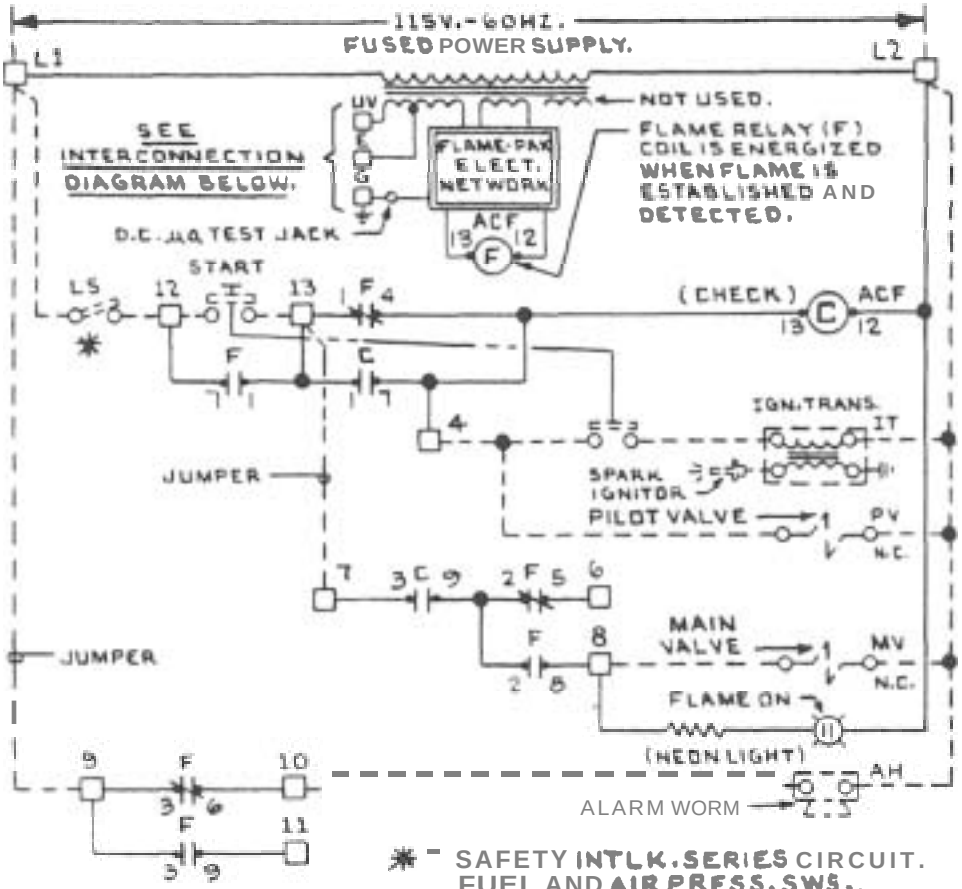
SINGLE BURNER
PROTECTOFIER
(FORM 6642 VA
GROUP M2101.)



NO CONNECTION.

INTERNAL WIRING.

EXTERNAL WIRING.



* - SAFETY INTLK. SERIES CIRCUIT. FUEL AND AIR PRESS. SWS., VENT. FANS, ETC. AS REQ'D.

WIRING DIAGRAM

SINGLE BURNER
PROTECTOFIER
(FORM 6642 VA
GROUP M2101.)

115V.-60HZ. FUSED POWER SUPPLY.

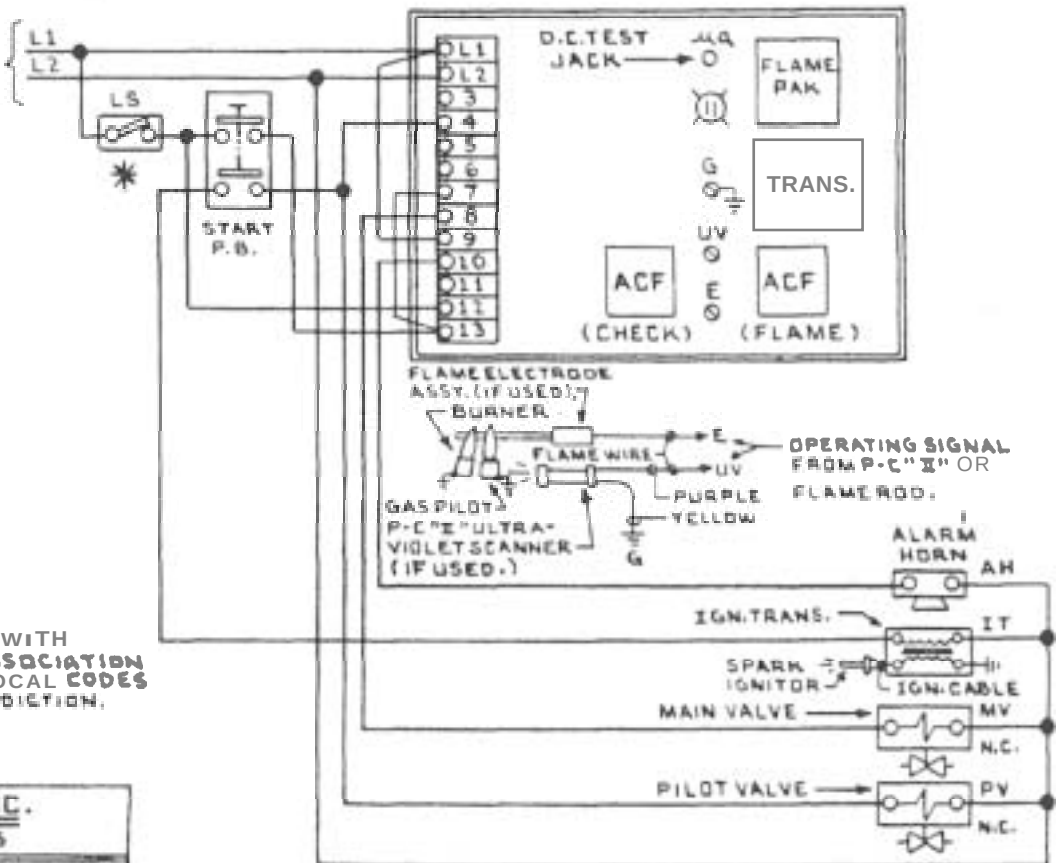
NOTES:

FLAME WIRE TO BE NO. 14 TYPE TW. 600V. INSULATED WIRE OR EQUAL. FLAME WIRE MUST NOT BE IN SAME CONDUITS WITH POWER WIRING.

IGNITION CABLE MUST BE RUN IN SEPARATE CONDUIT TO SPARK ELECTRODE. (DO NOT MIX WITH 115V. WIRING.)

WIRING AND INSTALLATION TO CONFORM WITH NATIONAL AND LOCAL ELECTRICAL CODES. ALL WIRING AND EQUIPMENT EXTERNAL TO PROTECTOFIER TO BE FURNISHED BY OTHERS UNLESS OTHERWISE SPECIFIED.

INSTALLATION, OPERATION AND MAINTENANCE SHALL CONFORM WITH NATIONAL FIRE PROTECTION ASSOCIATION STANDARDS, NATIONAL AND LOCAL CODES AND AUTHORITIES HAVING JURISDICTION.



INTERCONNECTION DIAGRAM

PROTECTION CONTROLS, INC.
SKOKIE, ILLINOIS

WIRING DIAGRAM FOR:
PROTECTOFIER FORM 6642 VA GROUP M2101

JOB NO.	DRWN. BY	DATE	DRAWING NO.
	H.R.V.	5-30-79	X-235

REVISED AND REDRAWN. REV. 9-30-81

GSI GROUP

Limited Warranty

The GSI Group, LLC. ("GSI") warrants products which it manufactures to be free of defects in materials and workmanship under normal usage and conditions for a period of 12 months after sale to the original end-user or if a foreign sale, 14 months from arrival at port of discharge, whichever is earlier. The end-user's sole remedy (and GSI's only obligation) is to repair or replace, at GSI's option and expense, products that in GSI's judgment, contain a material defect in materials or workmanship. Expenses incurred by or on behalf of the end-user without prior written authorization from the GSI Warranty Group shall be the sole responsibility of the end-user.

Warranty Extensions: The Limited Warranty period is extended for the following products:

	Product	Warranty Period
AP Fans and Flooring	Performer Series Direct Drive Fan Motor	3 Years
	All Fiberglass Housings	Lifetime
	All Fiberglass Propellers	Lifetime
	Apex Flooring	10 Years *
Cumberland Feeding/Watering Systems	Feeder System Pan Assemblies	5 Years **
	Feed Tubes (1.75" & 2.00")	10 Years *
	Centerless Augers	10 Years *
	Watering Nipples	10 Years *
Grain Systems	Grain Bin Structural Design	5 Years
	Portable Dryers	2 Years
	Portable Dryer Frames, Screens and Internal Infrastructure †	5 Years

* Warranty prorated from list price:
  0 to 3 years – no cost to end-user
  3 to 5 years – end-user pays 25%
  5 to 7 years – end-user pays 50%
  7 to 10 years – end user pays 75%

** Warranty prorated from list price:
  0 to 3 years – no cost to end-user
  3 to 5 years – end-user pays 50%

† Motors, burner components and moving parts not included

Conditions and Limitations:

THERE ARE NO WARRANTIES THAT EXTEND BEYOND THE LIMITED WARRANTY DESCRIPTION SET FORTH ABOVE. SPECIFICALLY, GSI MAKES NO FURTHER WARRANTY OF ANY KIND, EXPRESS OR IMPLIED, INCLUDING, WITHOUT LIMITATION, WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE OR USE IN CONNECTION WITH: (i) PRODUCT MANUFACTURED OR SOLD BY GSI OR (ii) ANY ADVICE, INSTRUCTION, RECOMMENDATION OR SUGGESTION PROVIDED BY AN AGENT, REPRESENTATIVE OR EMPLOYEE OF GSI REGARDING OR RELATED TO THE CONFIGURATION, INSTALLATION, LAYOUT, SUITABILITY FOR A PARTICULAR PURPOSE, OR DESIGN OF SUCH PRODUCTS.

GSI shall not be liable for any direct, indirect, incidental or consequential damages, including, without limitation, loss of anticipated profits or benefits. The sole and exclusive remedy is set forth in the Limited Warranty, which shall not exceed the amount paid for the product purchased. This warranty is not transferable and applies only to the original end-user. GSI shall have no obligation or responsibility for any representations or warranties made by or on behalf of any dealer, agent or distributor.

GSI assumes no responsibility for claims resulting from construction defects or unauthorized modifications to products which it manufactured. Modifications to products not specifically delineated in the manual accompanying the equipment at initial sale will void the Limited Warranty.

This Limited Warranty shall not extend to products or parts which have been damaged by negligent use, misuse, alteration, accident or which have been improperly/inadequately maintained. This Limited Warranty extends solely to products manufactured by GSI.

Prior to installation, the end-user has the responsibility to comply with federal, state and local codes which apply to the location and installation of products manufactured or sold by GSI.

This equipment shall be installed in accordance with the current installation codes and applicable regulations which should be carefully followed in all cases. Authorities having jurisdiction should be consulted before installations are made.

GSI GROUP

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Assumption, IL 62510-0020
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